# Compressed Air Magazine

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## DECEMBER, 1922

*CIRCULATION THIS ISSUE*
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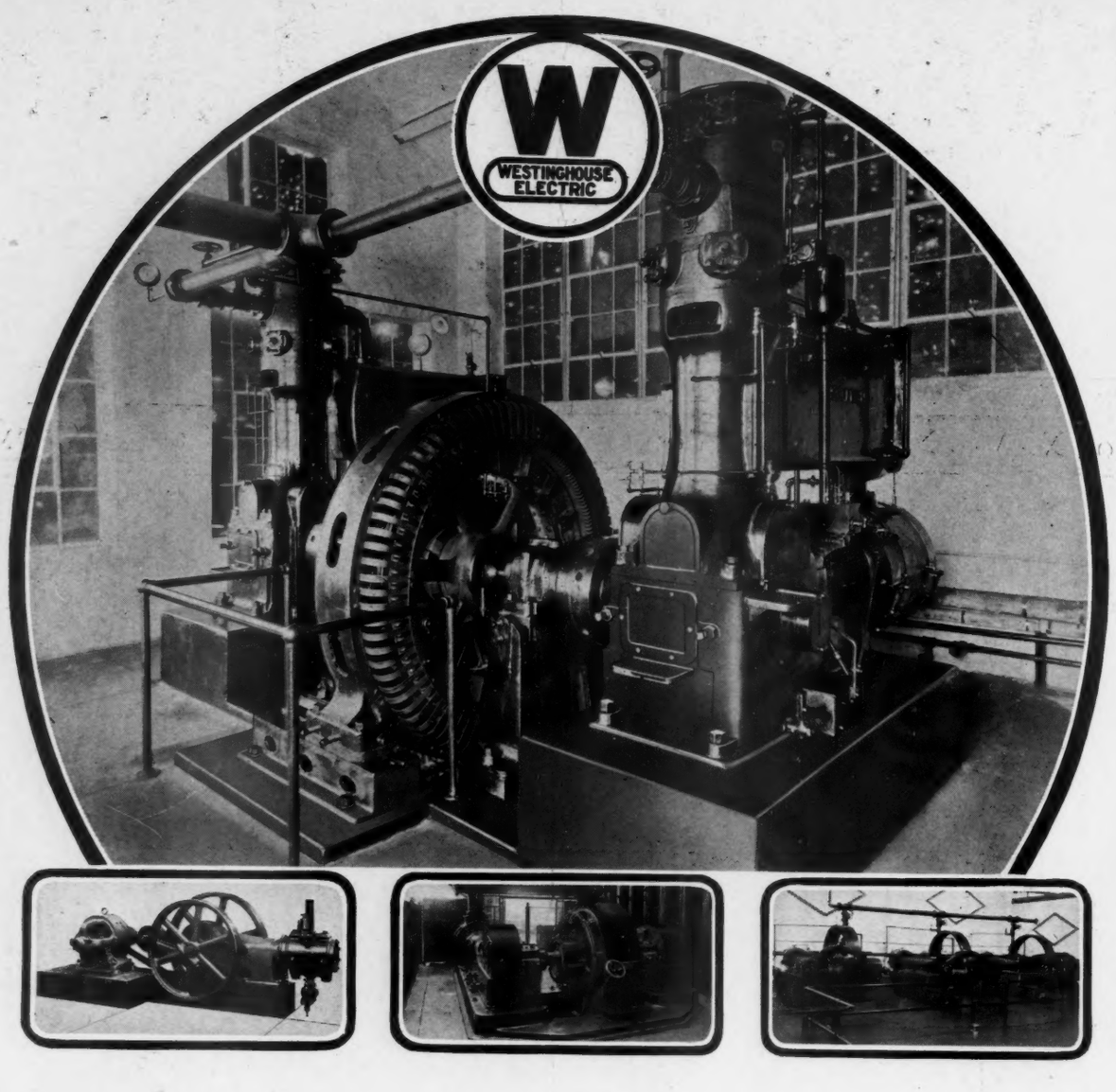
*CONSTRUCTION OF SECTION OF DIXIE HIGHWAY SHOWING LAYING OF MODIFIED TELFORD BASE*

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Compressed Air Magazine

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VOL. XXVII, NO. XII

DECEMBER, 1922

# How Leather for the Upholstering of Automobiles is Made

## Compressed Air a Great Aid in Speeding Up Production in This Rapidly Expanding Branch of the Leather Industry

By ROBERT G. SKERRETT

LEATHER FOR upholstering purposes has been produced in the United States for a good many years, but the demand for this commodity has increased latterly at a rapid rate and mainly because of our greatly augmented output of automotive vehicles. As a matter of fact, automobiles are to-day responsible for the manufacture of most of our upholstery leather.

Some idea of how this branch of the leather business has grown can be gathered from figures recently furnished by the United States Bureau of Census. In 1904 the total value of upholstery leather produced in this country amounted to $7,780,804. Ten years later the output was worth $14,328,358; and in 1919, our tanneries supplied leather of this sort to the value of $31,916,700. Since then, plants have been expanded or built anew capable of considerably amplifying previous production.

It is authoritatively declared that leather is superior to any textile for the upholstering of automobiles. The reasons are that leather will not take up dirt or dust like cloth; that it does not spot easily; that it can be readily wiped off or cleaned; and that it is, generally speaking, therefore more economical, satisfactory and sanitary. Well-nigh all of the better grades of cars are upholstered with leather; and first-class leather will ordinarily outlast the life of any car in which it is used. The domestic demand for this material is so great that we have relatively little of the commodity left over for export.

In the manufacture of upholstery leather, American establishments have achieved notable success; and to this end it is now the practice with the best of them to employ thoroughly up-to-date facilities—some of them of a distinctly specialized character. As a result, the goods are extremely durable and are given a variety of finishes which makes it possible to suit the tastes of a wide range of car builders and purchasers.

In the order mentioned, New Jersey and Ohio lead in the production of upholstery leather; and the purpose of the present article is to describe the procedure as practiced by one of our foremost plants—that of the General Leather Company of Newark, N. J. Many of us who find real comfort in the tufted seats and backs of the country's millions of automobiles should be particularly interested in the story we have to tell. Probably only a few of us have more than a hazy idea of how hides are tanned and the resultant leather coated so that it will answer the upholsterer's requirements. Leather for the car maker must be able to withstand far harder service than that imposed upon the familiar armchair, and yet the material must lack in nothing that appeals to the eye.

**WITH 10,000,000 automobiles in service throughout the country, and with many plants engaged in turning out new cars annually at the rate of hundreds of thousands, the upholstering of these vehicles calls for the preparation of great quantities of suitable materials.**

**Experience has proved that leather is notably superior for this use; and the great majority of the higher-priced automobiles are upholstered with it. Because of this fact the upholstery branch of the leather industry has expanded in a marked degree during the last few years in order to meet the demand for its specialties.**

**The manufacture of upholstery leather differs in a number of respects from the processes employed in the tanning and the finishing of other kinds of leather; and the purpose of this article is to explain these differences and, incidentally, to disclose how compressed air aids in the making of a superior commodity.**

The modern method of tanning sole leather was dealt with in the July issue of the Magazine, and it was mentioned at the time that leather of that sort was made from hides which had their origin in Argentina. The raw material for upholstery leather is obtained principally from domestic packers. The hides desired are what are termed "spready steers"—in other words, those of large area which will furnish big pieces for use in automobiles. The establishment in question specializes in this branch of the trade. Sole leather is sold by weight, while upholstery leather is marketed by superficial measurement.

A period of 40 days is required between the time the hides are first taken in hand until they are turned out in the form of the finished product. At present, the plant can deal with 1,500 hides a day. Inasmuch as each hide is split three times during treatment, this means that the number of pieces to be handled is increased fourfold. We shall take up the details of the splitting process when we come to that stage of the manufacturing cycle. There is much to be told before then about the means employed in transforming the green-salted hides into leather—that is, converting a putrescible material into a durable substance which will withstand much wear and tear.

After the heads and ears are cut off, the hides are put in water to soak over night. This loosens the dirt and softens any dried blood which may be clinging to them. Next, the hides are run through a brushing machine, which takes off light fat and otherwise cleans them. With this done, the hides are ready for "liming." The purpose of this process is to plump the hides and to facilitate the removal of the hair. This is an important phase of the tanning operations.

The hides are kept in the lime liquor for from six to seven days. For the first 24 hours

*The hides are hung on frames before they are lowered into the lime liquors.*

the bath is a relatively weak one; the next day the hides are treated with a stronger solution; and the remaining periods are spent in still stronger lime liquor. To prevent the lime from precipitating, all of the baths are agitated daily at intervals with compressed air. A pipe, ten feet long and half an inch in diameter, is connected by hose with the air-distributing system; and air, at a pressure of 45 pounds, is discharged from the pipe when the latter is plunged into the liming pits. This procedure is far more satisfactory than stirring in any other way, and makes certain that the lime liquor will be of equal strength throughout and capable of acting uniformly upon all of the hides in a pit.

Upon coming out of the last of the liming pits, the hides are run through an unhairing machine where they are subjected to the scraping action of cylinders carrying a series of dull, helical blades—half of the blades slanting from right to left and the remainder from left to right. This arrangement of the blades serves the twofold purpose of removing the loosened hair and of slightly stretching the hides at the same time. This work used to be done by hand. From the unhairing machine, the hides are passed through another machine of a kindred character which scrapes off any flesh clinging to the inner or under side of the hides. Any fine hair or flesh remaining after the treatments just described is got rid of manually.

The hides are now ready for the bate paddles, by which they are subjected to a deliming process. The get-up of these paddles is shown in one of our illustrations. The bating goes on for two days—the first day the liquor is a mild one and the second day it is somewhat stronger. Among other things, the bate contains a patent compound, meal, and sal-ammoniac, and the effect is to produce a decidedly plump hide free of all trace of lime. From the bate paddles the hides are put into wash paddles, and there the clear water and the revolving wheels remove the last of the bate. The hides are now in a condition for the first step in actual tanning—their plumpness making them receptive to the penetrative action of the tanning liquor. Before going into the tanning pits, however, the hides are given a bath in warm water.

The tanning period covers an interval of from six to eight days; and the hides are treated every 24 hours with a liquor of increasing strength. All the while, the hides, suspended from frames, are moved up and down in the tanning mixture by a mechanical arrangement called a rocker. The tanning liquors are vegetable extracts. If the liquor were too strong at the start, the outside of the hides would be "burned." This would tend to arrest any further penetration of the tannin; check the preserving process; and cause a cracking of the grain—the most valuable part of the hide.

In order to stimulate the action of the tanning liquors and to maintain their effectiveness while the hides are in soak, the practice at the plant of the General Leather Company is to "plunge" or to agitate the mixtures by compressed air in the manner already described in the case of the lime liquors. This agency, apart from gains in economy and efficiency, speeds up the work and contributes in a marked degree to the making of a superior leather—for such the hide is when it emerges from the last of the tanning pits.

The wet leather is next pressed between felt-covered rolls, which act like clothes wringers; then, after it has been dealt with at "preparing tables" where the sides of leather have their ragged edges trimmed off and their superficial discolorations removed, the leather is carried to the "stoning jack." This machine is, in effect, a pendulum equipped with a roller, and the latter smooths out, stretches, and imparts a light polish to the leather. "Rough necks," sides of leather which naturally have a somewhat crinkled surface, are smoothed out by hand with a shaver. The leather at this stage is much too thick for upholstering purposes; and before it is ready for the finishing or coating treatment it must be split into four sheets or pieces. This is done by an ingenious but, withal, fairly simple apparatus.

The splitting machine consists of a series of wide, cylindrical rolls which grip the leather and guide it edgewise against a very sharp and rapidly moving band-knife, which can be set to produce a "split" of any desired thickness. The cutting edge of the knife runs between two emery wheels, and these serve to keep the knife as sharp as a razor. As the leather passes through the first of these machines, the "grain"—that is, the outer or superior layer of the hide—comes out on top and is laid aside, while the remainder is put through a second machine which shears off, in a similar fashion, the first split. Finally, a third machine divides what remains of the side of leather into a second split and a fourth sheet, called a "slab." The General Leather Company sells its slabs without further handling them.

The grain and the two splits are subjected to retanning for about six days—the procedure differing from the previous tanning in that the leather is treated in paddles—the tanning liquor being increased in strength daily. Oil is added to the solution progressively after the leather leaves the first paddle. Upon issuing from the last of the tanning baths, the leather is paddled in clear water. The tanning liquors are held at a temperature ranging between 75 and 80 degrees Fahrenheit. The splits are semi-chrome tanned.

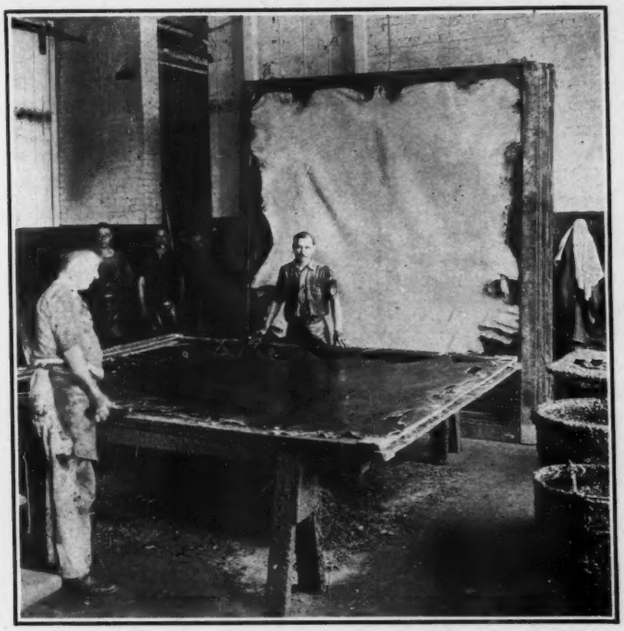
With this work concluded, the grains and

*In the Graining Department where the coated leather is rubbed on the reverse side for the purpose of bringing out the original grain of the leather.*

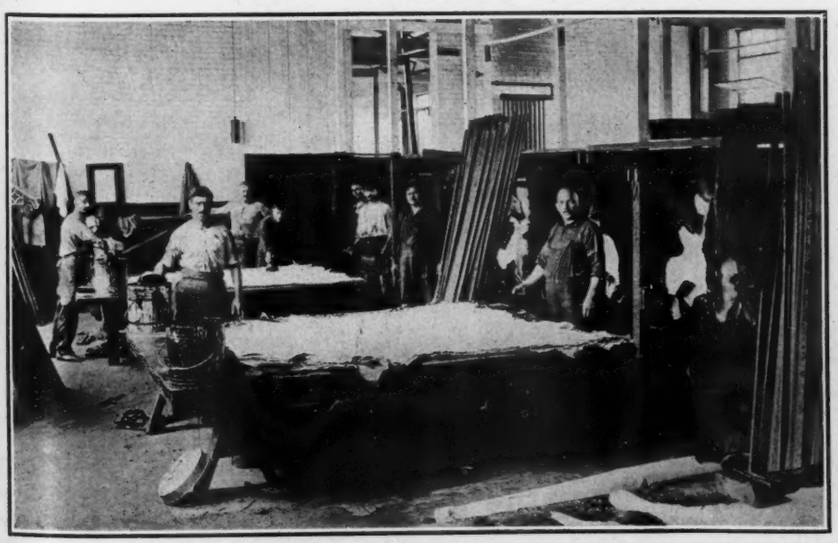
*By running the uncoated leather through the rolls of a softening machine the material is made to resemble suede.*


*The grains of the split hides, after receiving a surfacing coat, are tacked and stretched on frames and then placed outdoors to dry in the sunshine.*

*In the Patching Room, tears, holes, and other defects are filled or mended so that the leather appears unblemished when coated.*

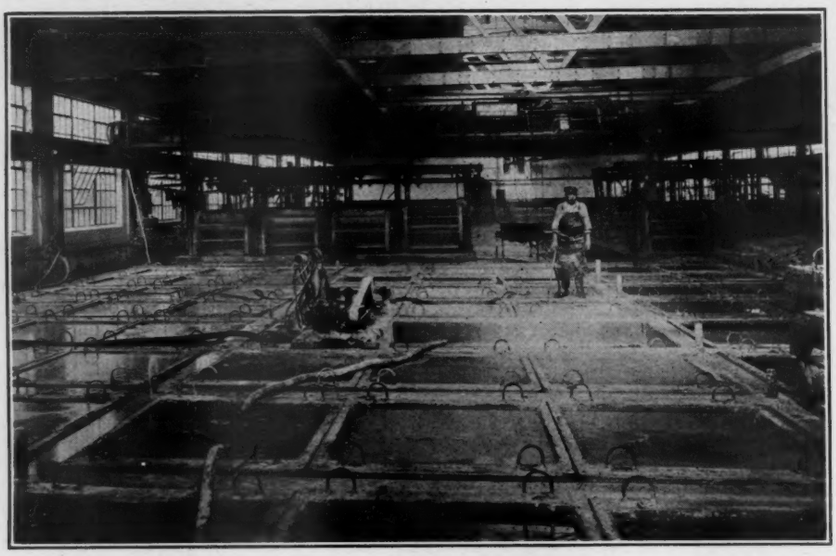


*It takes between six and seven coats of finish, all of them applied by hand, to produce a high-grade article.*



*The first thing in finishing leather for upholstering purposes is to give it a coat of "daub" or filler.*

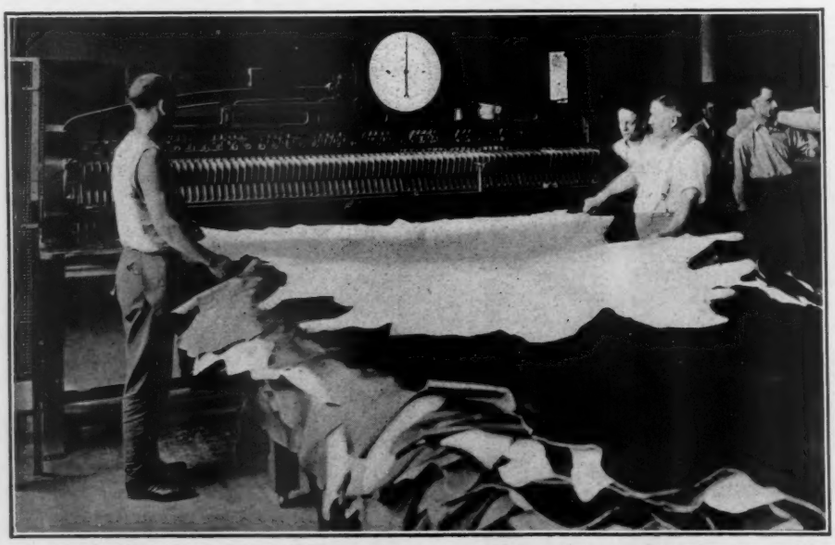
*The finishing composition for splits is sprayed on by compressed air.*



*A workman "air plunging" the lime liquor in which the hides are softened to facilitate removal of the hair.*

the splits are placed on tables where they are "stuffed" with a fish-oil mixture which is brushed in by hand. With the stuffing completed, the leather is taken to the Tacking Loft, where it is hung over frames, stretched, and held in position by large-headed, 1-inch tacks. The tackers are very skilful, and handle their hammers and drive the tacks with astonishing rapidity while stretching the leather over the frames. There is a chance in this department for some inventive genius to effect a substantial saving. As it is, all tack holes must be cut away, and this means a loss of from two to three square feet on every piece of leather. The material stays in the tacking and drying loft for 24 hours. Drying is accelerated by electric fans; and this action is assisted in cold weather by steam heat. The temperature is not allowed to drop below 75 degrees Fahrenheit or to rise above it, as too much heat produces a hard leather.

On leaving the loft, the dried splits and grains are sent to the Sorting Department, where the russet leather is classified. Next, the leather is shaved by machines fitted with reverse helical blades. The shaved grain leather is then run through a softening machine having one cork covered and one rubber covered roll. These rolls revolve oppositely, and the leather when it comes from them feels much like suede. The splits are softened in revolving drums. This takes half a day; and 100 splits are treated at a time. When properly softened, the leather is transferred to the Patching Room, where each piece is carefully inspected for defects and all holes and tears are nicely patched by expert workers who use fish glue and either bits of leather or leather fiber for the purpose. The filling or patches are applied on that side of the leather which is not to receive the coating composition. The repairs are durable and so well done that they are not apparent when the leather has been given its ultimate finish. The leather, at this point, is marketable: many tanners do not finish; and many finishers do not tan.



*Upholstery leather is sold by the square foot. This ingenious machine registers the superficial area of irregular pieces of leather.*

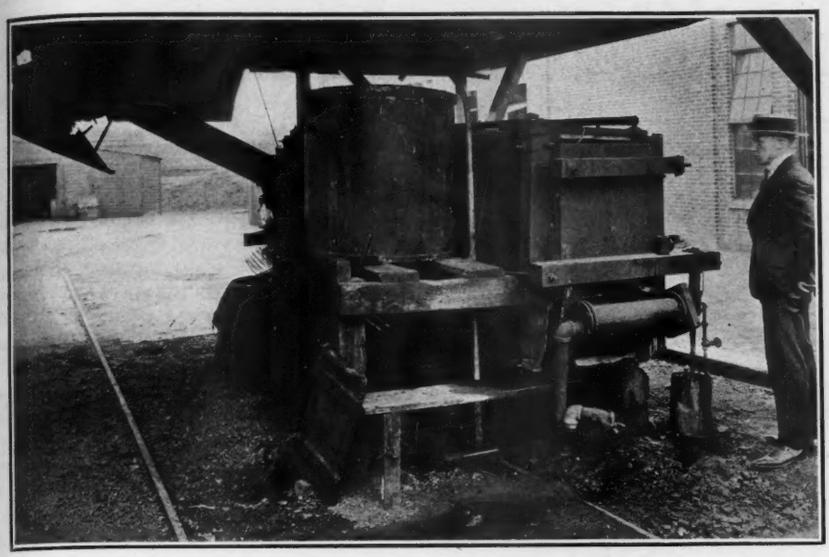
We have so far followed the leather through the various steps preparatory to its handling in the Finishing Department; and from now on we shall see how the grains and the splits are treated somewhat differently to fit them for the upholstering of automobiles. Inasmuch as the grain is the superior material, we shall describe its surfacing first. At the start, with the outer or grain side uppermost, the leather is tacked on frames and given a coat of "daub"—a mixture of linseed oil. This composition plays the part of a priming coat upon which to build up a main finish; and the stuff is spread on by hand with slickers. The daubed leather is then put for a day in steam-heated ovens or chambers.

On coming from the ovens the grains are stretched upon frames, to which they are secured by clips, cords, and tacks. With this work done, the frames, with their attached leather, are set outdoors to sun, and they are left there all day. Somehow, no satisfactory substitute has yet been discovered for Old Sol's rays; and the action of the free air and the sunshine serves to dry or to oxidize rapidly the linseed oil of the daub. Care must be taken to guard against showers, because wetting the leather would throw the finishing process back quite two days. The General Leather Company has, all told, 2½ acres of sun racks.

After a day in the sun, the leather receives a second coat of finish; then goes once more into the ovens for a night, where the temperature ranges from 150 to 200 degrees Fahrenheit; and the following morning, still upon the frames, it is set out in the open for another sun bath. This cycle is repeated until the leather has been given six or seven coats. Each of these is brushed on skilfully by hand, and the cumulative result is a smooth, shiny, flexible coating of black, brown, red, blue, etc., according to the demands of the trade.

Splits are daubed and coated without stretching—being merely hung over poles to dry; and they are finished with collodion or "dope." The finishing fluid is at times blown onto the splits by spraying apparatus under the impulse of compressed air. Because the coated splits lack the characteristic texture of the natural grains, it is customary to impart artificially to this leather various sorts of surfacings. Whether this consists of embossing or "smooth plating," the work is done by a powerful press in which the leather is simultaneously subjected to a heat of 200 degrees Fahrenheit and a pressure of about ten tons to the square inch.

On leaving the Finishing Department, the grains pass to the Graining Department. There, the leather is laid upon slanting tables and rubbed on the nether side by boards covered with corrugated rubber. This work is done by hand; and the treatment restores or brings up to the surface the original grain which has for the time being been lost beneath the superposed composition. Upholstery leather made from the grains commonly brings about 50 per cent. more in the market than that obtained from the splits. The General Leather Company is able to produce between 3,000,000 and 5,000,000 square feet of material

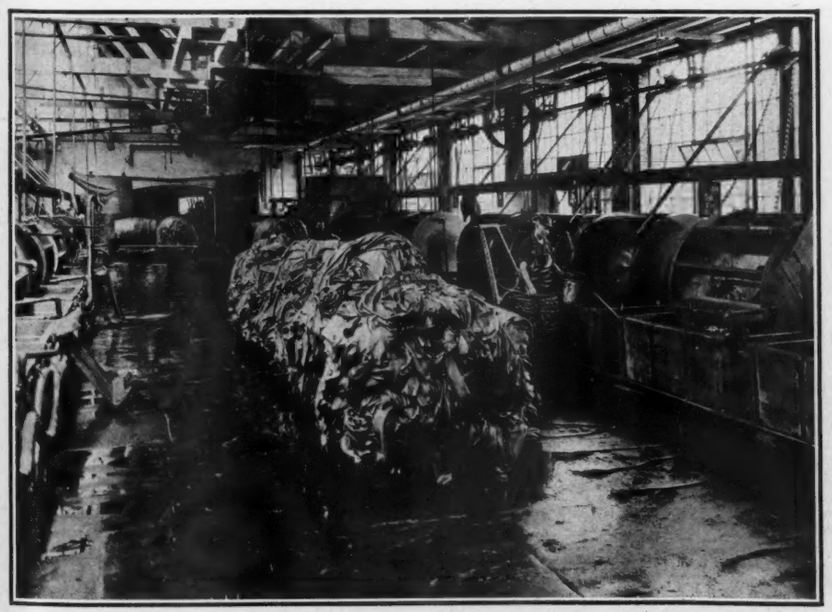


*Large quantities of naptha are used to dilute the boiled linseed oil which forms part of the leather finishing mixture. For the sake of economy and safety the naptha vapor is recovered from the steaming oil. Compressed air is used in this reclaiming process.*

a month, which, at prevailing prices, would have a total value exceeding $500,000.

Aside from the uses to which compressed air is put in the liming and the tanning pits, it is employed extensively throughout the establishment for cleaning machinery of divers descriptions, and is especially helpful in keeping the somewhat sensitive measuring machine in condition for its exacting and important work. Every piece of leather is run through this apparatus and its superficial area determined before it goes to the packing and shipping departments. Compressed air is also utilized in recovering naptha during one of the processes.

Naptha is used to reduce or to thin the boiled linseed oil or daub. The oil comes from the kettles in the Boiling Shed at a temperature of from 300 to 500 degrees Fahrenheit, and is thickened by that treatment. The practice is to put a cover over the arriving kettle and then to add, through a connecting pipe, the needful quantity of naptha. The vapor given off from the steaming kettle is led to a coil in a near-by tank and condensed, and, by a suitable arrangement, the naptha so recovered drops into a trap whence it is forced by compressed air up and into a metal receiver. In this way, the naptha can be employed over and over again. Aside from the economy effected, the recovery plant serves to prevent the escape of the inflammable volatile—a real step in the direction of added safety.



*When the limed hides have been unhaired they are put in the "bate paddles" at the left preparatory to tanning.*

## AN AIR BELL WITHIN A COFFERDAM

IN THE construction of a new pier for a B. & O. R. R. bridge over the Alleghany at Pittsburgh the operations were somewhat unusual. The depth of the water was twelve feet with four feet of sand and gravel, and under this was shale and sandstone. The site was dredged to a depth of eighteen feet and a cofferdam was constructed with an inside area of 17.5x58.5 feet. It was found impossible to pump out the cofferdam satisfactorily and, accordingly, an air bell was built with outside dimensions of 12x48 feet and five feet high inside with three air-locks in the top. This air bell was lowered to the bottom of the excavation within the cofferdam and all the space of two feet six inches around it was filled with tremie deposited concrete and the top of the bell then covered, making it both air and water tight.

Air pressure was next applied to the interior of the bell and the water was expelled up through a pipe reaching down to the bottom. Workmen were then able to remove all the underlying soil and to continue the excavation six feet into the rock, which was quite soft. The filling of the excavation and of the entire interior of the air bell was performed under air pressure, the solid concrete construction being thus brought above the water level. The air bell was of light construction, and the conditions under which it was used were less strenuous than those in the case of the typical and familiar pneumatic caisson.

## TESTING THE EFFICIENCY OF LEATHER BELTING

TESTS made of leather belting by the Leather Belting Exchange, Philadelphia, show that, with a reasonable shop tension, a transmission belt with its flesh side in contact with the pulleys will average only about 50 to 60 per cent. as much power as when the grain side is in touch with them. On the other hand, at higher tension, the flesh side will do much better, averaging from 50 to 100 per cent. more power than the grain side, the results depending, of course, on the belt and the conditions of service. For the experiments, five 4-inch, 30-foot, single belts of different make, weighing from sixteen to eighteen ounces, were used. The conditions were standardized, and the belts were all thoroughly "run in" before the tests were made.

The following test, conducted at the same time, strikingly illustrates the low efficiency of a new belt. When first put on the pulley, the belt transmitted 12 H.P. at a slip of 1.2 per cent. After turning for five hours it transmitted 19 H.P. with the same percentage of slip; after thirteen hours it transmitted 24 H.P.; while after twenty hours it transmitted 31 H.P. with a slip of 1.6 per cent. According to the horse-power tables its scheduled transmission should have been 26 H.P.

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The United States supplied 62 per cent. of the world's production of crude petroleum in 1921 and imported an additional 17 per cent., chiefly from Mexico.

# The Geophone in its Perfected Form

## This "Mechanical Ear" Is Lending Itself to Many Helpful Applications in Industry

By C. MORAN

A MECHANICAL EAR, rivaling in acuteness the sharpest hearing of a rodent, is now used to detect leaks in compressed air lines and water mains. With it the light tapping of knuckles on a pipe line is audible at a distance of 1,500 feet; water can be heard circulating in mains ten to fifteen feet below the surface of the street; and ordinary talking and singing can be picked up with the device through 150 feet of solid coal in a mine. With the instrument, an Arizona mining company recently located leaks in compressed air lines under 1½ to 2½ feet of fine rock fill.

The apparatus is a development of the geophone, invented and used by the French during the war to detect the sapping and tunneling operations of the enemy. It was realized then that the device would be of great value in peace-time both in mine rescue work and in locating leaks in pipe lines; and United States engineers, connected with the Bureau of Mines, have developed it to a remarkable degree of sensitiveness.

The instrument is a small seismograph and embodies the same principles as the ponderous apparatus that records earthquake tremors. It consists of a lead weight suspended between two elastic diaphragms cutting across a small air-tight box, as shown in the illustration. The case itself, is a cast-iron ring about 3½ inches in diameter. The lead weight, in the center, is fastened by means of a single bolt passing through two metal discs, one of which covers the top and the other the bottom of the iron ring. There are two brass cap pieces, the upper one having an opening in the middle to which is fastened a rubber tube leading to a stethoscopic earpiece. These cap pieces are secured by bolts to the iron ring; are slightly recessed; and serve to hold the diaphragms in place.

If the instrument is placed on the ground, and anyone is pounding or digging in the vicinity, the energy, transmitted through the earth in the form of wave motion, shakes the geophone case. The geophone transforms the earth wave into an air wave, and, at the same time, magnifies the wave so that the sound is louder than if the ears were placed in direct contact with the earth. Usually two instruments are used, one for each ear.

The Arizona company referred to has two parallel compressed air lines, about 1½ miles long, buried beneath an average of two feet of fine rock fill. One of the lines is a 4-inch, high-pressure (1,000 pounds) main, and the other a 10-inch, low-pressure (90 pounds) main. The two mains are separated by an interval varying from ten to 30 feet, and run from the compressor plant to No. 2 shaft, where they are taken underground. A pump line is also run below ground in the immediate neighborhood.

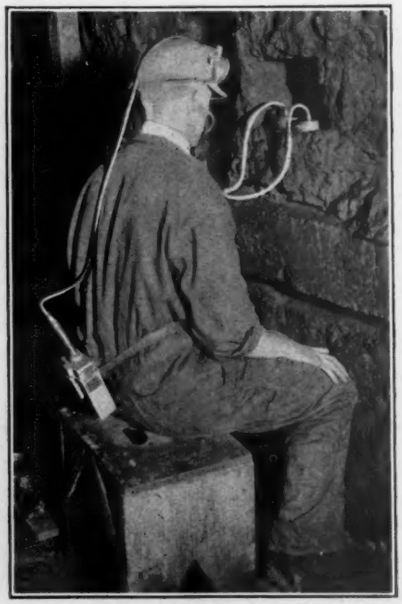
Several leaks, not sufficiently audible to be located without mechanical aid, developed in the mains. Geophone readings were taken at 7-foot or 8-foot intervals, directly over the lines, with the compressors inoperative and the pumps shut down. The valves in the far end of the surface mains were then closed, and full pressure pumped into the lines. Several leaks in the high-pressure main were heard at distances varying from fifteen to 30 feet, and a considerable leak in the low-pressure line was detected at ten feet.

At a street crossing, in the business district of Pittsburgh, water was found seeping through the joints of the paving blocks. The sound of running water was audible through the geophones placed upon the paving at this point, and seemed to be coming from the north. The water company had been trying for two weeks to locate this leak, but without success. The sounds were followed back to a gate-box, some distance away from where the water appeared at the surface, where they were very loud. At a street intersection the sound of running water was supplemented by a hissing noise which could be heard anywhere within a radius of 40 feet. Determinations of direction were made, and the position of the leak was established at the center of the meeting streets. As a result only one hole had to be dug in the busy thoroughfare to repair the break in the main.

*Underground sounds can be heard at considerable distances by the use of this listening device.*




*Cross-section of one of the elements of the apparatus.*



Photos, U. S. Bureau of Mines.

*Coal miner locating the position of entombed miners by using the "mechanical ear."*

In another case, there was a leak in a 1-inch pipe leading from a street main to a private residence. The sound made by the leak could be heard by placing the ear to the pipe, in the cellar of the house. With the geophone the leak was accurately located, and was found to be fifteen feet away from the house.

The geophone has also proved of great value in mine rescue work, and the Bureau of Mines has equipped all of its rescue cars with the device. In tests, conducted at an experimental coal mine near Pittsburgh, Pa., blows with a sledge on the coal face were audible at a distance of 650 feet although various chambers and entries intervened. Mine fires are located by its use; the sounds of fire having been heard through 100 to 300 feet of cover and through as much as 500 feet of coal. In tunneling, it is now the practice to direct the breaking through of the last barrier between two oppositely advancing headings by means of this novel device; and it is also usefully applied in surveying mines and in preventing accidents in blasting operations.

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Experiments conducted about two years ago have proved that Cuban *majagua* is an ideal wood for the manufacture of baseball bats. *Majagua* has a tough fiber and can be used for any purpose requiring a wood that will not break easily. Within the past year a growing interest in *majagua* has developed in the United States, and importations of this wood have been made for the manufacture of baseball bats. For this purpose the material is cut into pieces 38 inches long and three inches square. One Cuban firm exported to America, during the period mentioned, 1,000 of these pieces.

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A company has been organized in Norway to manufacture a type of motor sled which is intended to take the place, in winter-time of the usual front wheels of automobiles and trucks.

# Compressed Air Used to Sink Unusual Mine Shaft

## Dravo Contracting Company Carries Caissons for Coal Mine Shaft Through 160 Feet of Water-Bearing Sand and Gravel

By E. T. GOTT*

**THE AMERICAN public has by now fully awakened to the importance of coal in the daily life of the nation. Newspapers and magazines have devoted front pages and leading articles to the great strike, its solution, and its effects. Fuel administrators have been appointed in every state to apportion equitably the meager supply of coal so that human suffering might be minimized and the wheels of industry slowed up as little as possible.**

**In the language of "The Street," as the financial district of New York City is familiarly known, "Coal is King." It will, therefore, be more readily appreciated why an enterprising concern should undertake a difficult and unusual engineering task in order to reach a 22-inch seam of coal. The present article describes how this was done.**

THE GRASSELLI CHEMICAL CO., owners of an acreage of coal which is located five miles north of Terra Haute, Ind., had, for many years, entertained the hope of being able to put down shafts to open up the bed, known as Seam No. 4, underlying the property upon which their Spelterville plant is now located.

When the original proposal was sent out, the company realized that conditions were unusual, and that much study would have to be given to the problem before an intelligent bid could be made. The site was visited; bore-hole records were made; and it was shown that at the location of one of the shafts there was an overburden of 140 feet of sand and gravel, of which 111 feet was water bearing, and that the rock at the other site was 160 feet below the surface, with 105 feet of the overburden wet.

Hydrographs of the Wabash River were studied; the hydraulic gradients at various stages were plotted; and all data on the water conditions and the possibility of lowering the water were discussed. Records of shaft-sinking methods previously employed in the vicinity were then looked into, but most of these were of no suggestive value inasmuch as the mines are to the north of Spelterville, in the Clinton district and on the west side of the river, where surface conditions are quite different, and where no serious difficulties were encountered in carrying the shafts to the rock.

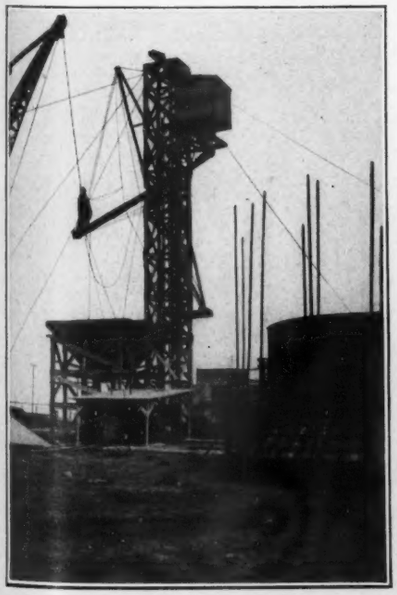
In most cases the shafts had been sunk in timber. Little or no trouble was experienced with water and running sand; and in the several instances where conditions were unfavorable to this open method, steel jacking plates, followed by skin-to-skin timber sets, were employed. Many of these undertakings, however, were failures, and in only a few of them did a plumb shaft result. It was impossible at all of the mines to shut off the water at the rock and it was evident after a visit to a number of them—upon noticing the condition of the timber lining and wondering at the flexibility of a cage that could follow such a necessarily crooked run of guides—that there would have to be an improvement in the case of the Grasselli job over the old timber method. It was the opinion that a pneumatic caisson would carry through the 160 feet of sand and gravel, and that it could be successfully sealed to the rock bottom despite the 51½-pound pressure required in the working chamber to overcome the hydrostatic head at this depth.

The contract (on a unit price basis, with additions and deductions for variations in depth over quantities indicated) was awarded in October, 1921, and the work was begun on November 9. The auxiliary shaft, for men and materials to the mine, was thirteen feet six inches inside diameter, with an 18-inch thickness of concrete lining in rock. The design of the caisson was left to the contractor, and sixteen feet, with a 1-foot 3-inch clearance all around, was considered sufficient to overcome the irregularities in sinking and the possibility of the caisson being slightly out of plumb when landing on the rock. The caisson walls were four feet thick, making the outside diameter of this shell 24 feet, heavily reinforced with steel rods horizontally and vertically, and fitted with lubricating pipes set in the concrete at intervals of twenty feet to provide, at eight points in its periphery, means of lubricating the outside surface with water, steam, or air forced through under pressure from the top of the shell. These pipes were much used in sinking, and, at times, when the shell became a little light, were an invaluable aid in reducing the skin friction which held it and also insured an even motion downward with the cutting edge occasionally crowding the digging.

The cutting edge was of heavy steel angle and plate construction, securely anchored to the concrete. The concrete forms were of collapsible steel segments and came in 8-foot vertical sections with four segments to the ring. This shaft was provided with three complete inside and two outside rings.

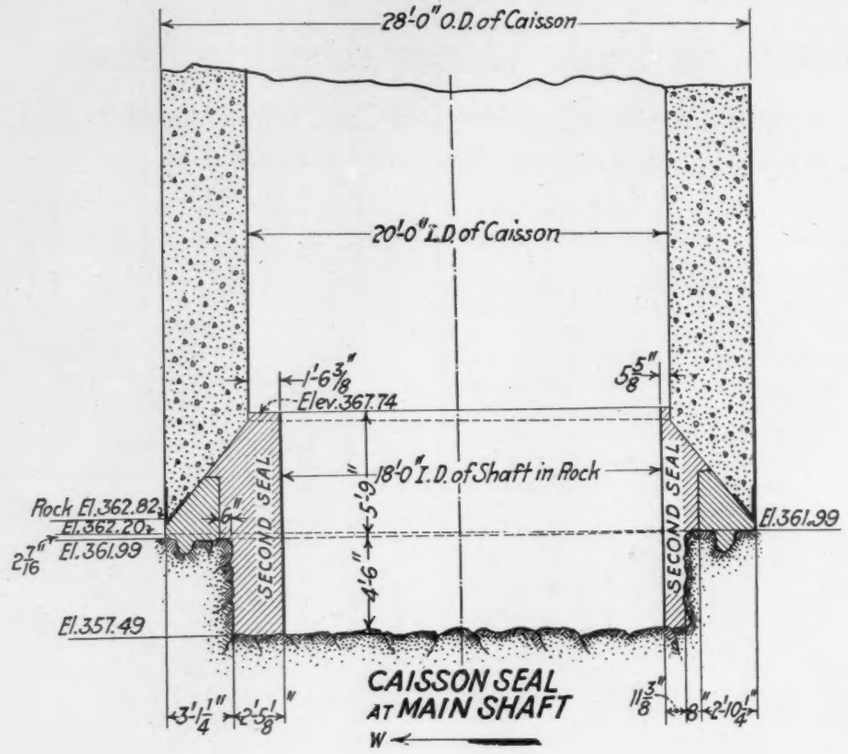
After the shoe had been set and riveted, and the first eight feet of concrete had been poured, sinking was started on December 9, from Elevation 491, and was continued in the open with an orange-peel bucket handling the excavation. Successive 8-foot lifts of concrete were added as required. The shoe struck water at

*Vice President, the Dravo Contracting Co., Pittsburgh, Pa.



*General view of operations at main shaft and the facilities employed during the sinking process.*

*Placing one of the inside forms before pouring concrete.*




a depth of 25 feet, Elevation 466, and when the point had submerged 33 feet the concrete deck was put in, 35 feet above the shoe, and preparations were made for air. This equipment was added January 8-17, 1922. On January 18, with the cutting edge at Elevation 433—58 feet below the surface—three 8-hour shifts were put in the hole under 16-pound air pressure. The material at this depth was entirely sand and gravel; and 6-inch blow pipes were used to remove practically all of it. If the caisson showed a tendency to stick, the lubricating pipes were brought into play, and the skin friction thus overcome.

The buoyant effect of the high-pressure air, and the lack of resistance of the fine sand immediately above the rock, made the caisson very unstable and hard to control. Just before it reached the rock it was badly out of plumb, and much time and labor were spent in efforts to land within the 15-inch allowance previously mentioned. Kickers were used on the low side at the surface; excavation was carried on diametrically opposite with the orange-peel bucket; and the caisson was relieved of earth pressure down to the water level—25 feet from the surface. Inside, a system of blocking was put under the shoe to retard the movement of the low side.

On February 25, when the shell landed on the coal seam just above the rock, it was 10⅜ inches out of plumb. It was found that the seam pitched twelve inches in the 24-foot width of the chamber with the high point of the coal, unfortunately, on the high side of the shell. The other side—after allowing for the difference in level of the shoe at the high and the low sides—was, therefore, about 10⅛ inches from a solid bearing.

With the coal seam pitching in exactly the opposite direction from that desired, it was necessary to block up the 10-inch gap on the low side of the shoe down to the top of the coal and to undercut along the high side until it was practicable to drop the cutting edge to the coal with an even bearing throughout its entire length, and with no material loss in its plumbness.

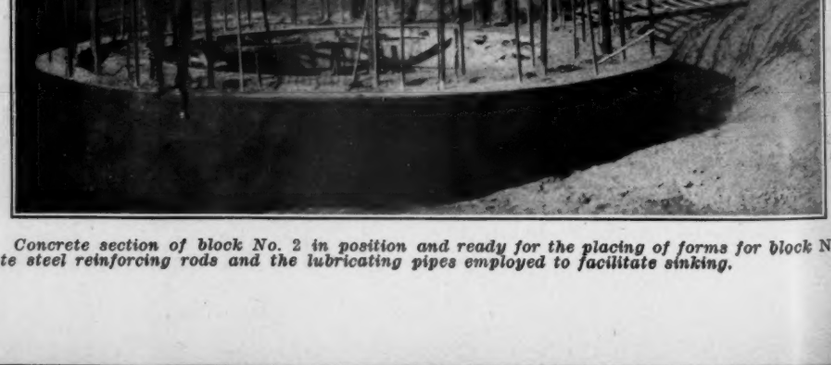
Below the 22-inch seam of coal occurred a vein of fire-clay, and it was in this impervious material that it had originally been planned to finally land the shoe and to seal the shaft. The removal of the coal was a very slow operation—all of the material having to be "locked out" in buckets and with shifts changing every half hour under pressures ranging from 49 to 51 pounds; and it was not until March 9 that it was possible to level up in the fire-clay for the last caisson drop. The shell, by this time, was very light, and was blown unsuccessfully for more than a week before it finally let go, landing evenly at Elevation 353.5 or the point at which the excavation had been squared up in the fire-clay. With each blow down during this period there was a large influx of sand and water: in some cases as high as 50 buckets having to be cleaned up with each reduction of pressure.

Calking the shoe was a matter of only a few days, using oakum and a very stiff grout. After carrying the excavation 2½ inches below the shoe—to Elevation 351—forms for the first half of the seal were placed, and on March 23 the concrete was poured. A pressure of 51 pounds was maintained until the 27th when, with the concrete sufficiently set, the compressor was stopped and the air gradually cut down to normal. It was found that the hole made thirteen gallons of water per minute. This it was believed could easily be taken care of in the second seal. A glance at the elevations will show that in sinking this shaft there was involved:

| | Elevation | |
|---|---|---|
| Dry excavation | 491.1 to 466.1 | 25 ft. |
| Wet excavation | 466.1 to 433.1 | 33 ft. |
| Pneumatic excavation | 433.1 to 351 | 82.1 ft. |

The water elevation at the time of seal was 466.65, giving the final hydrostatic head at 115.65 feet with a theoretical pressure of 50.2 pounds. A matter of 51½ pounds was actually carried when the first half of the seal was made on March 23. The air equipment was then removed and excavation in the open for the second half of the seal was begun on March 29, carrying the bottom in solid rock to Elevation 349, two feet below the level at which the first seal was made. On April 8, the final closure was made with grout pipes taking care of the 13-gallon per minute leakage. The stop-cocks on these pipes were later closed, and it was found that practically all of the water had been cut off. These holes are to be grouted; and this work is the last step in what is considered a highly successful undertaking.

Under the schedule for the job, and because



*Concrete section of block No. 2 in position and ready for the placing of forms for block No. 3. Note steel reinforcing rods and the lubricating pipes employed to facilitate sinking.*

of the possibility of failure of the method adopted by the Dravo Contracting Co., it was decided to work on one shaft at a time, having the second one ready for air when the first was sealed on rock bottom. Accordingly, the main shaft, having a 20-foot inside diameter, a 28-foot outside diameter, and a 4-foot thickness of shell, was not started until February 9 when, with the shoe set and riveted at Elevation 519, the first 8-foot lift of concrete was poured. The cutting edge reached the water —Elevation 463.5—on March 5, and the shell got down to Elevation 428, ready for the deck, on March 15. The steel girders and deck beams were placed by the 21st, and the concrete deck was poured on the 22nd. An additional form was placed on top of the shell on the 24th; and everything was then ready for the sandhogs. As previously stated the air equipment was moved over from the auxiliary shaft on March 29; and the caisson was put under compressed air on April 5.

As in the case of the other shaft, most of the material was blown through 4-inch and 6-inch extra heavy pipes, and only a small percentage was sent out in buckets. The rock pitched slightly where the caisson landed, but being very hard sandstone it was simply a matter of squaring up and sealing within ten inches of the top, at Elevation 362. This caisson, with an area of 616 square feet and with its deck 35 feet from the shoe, was very unstable under high pressure. When its top leaned in any one direction the natural tendency of the caisson was to continue in that direction, and this had to be fought against all the way down to keep within the 12-inch allowance. The shoe, being in fine sand which offered no resistance, could not be reasoned with, and attempts with kickers and blocking on the inside were decidedly a false move. Along with this system of blocking in the working chamber there was carried outside on the low side a similar group of kickers. With each blow-down these were brought into play, and the top, which leaned 24 inches on April 22, was thus brought back to ten inches when the caisson landed on the rock.

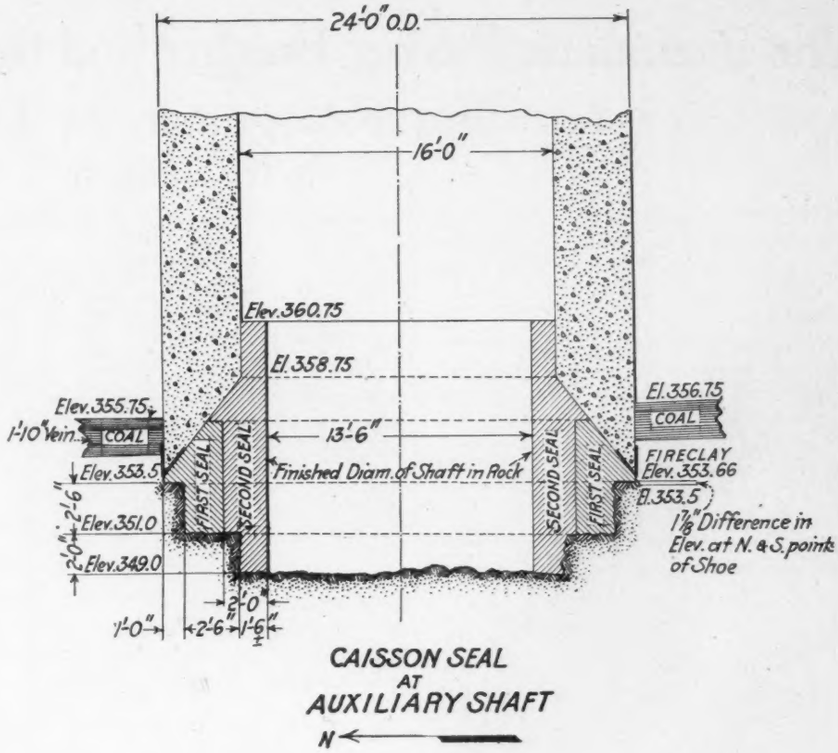
The cutting edge was calked June 1 and 2; forms for the first seal were set on the 3rd; and the concrete was poured on June 4. When the compressor was stopped on the 8th, the leakage was found to be two gallons per minute. An examination of the elevations at this main hoisting shaft shows that at the time of sealing there had actually been accomplished:

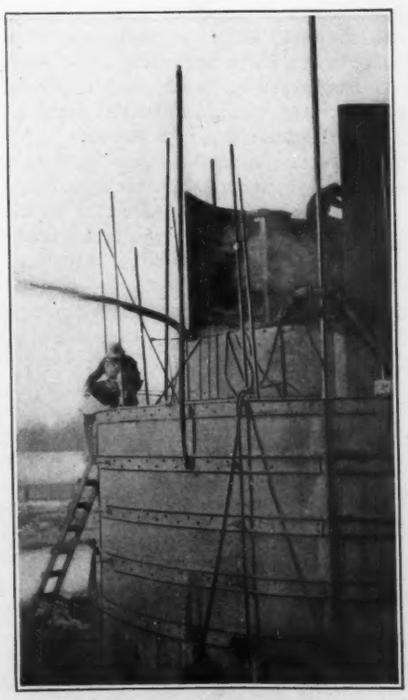
| | Elevation | |
|---|---|---|
| Dry excavation..... | 518.85 to 470.35 | 48.5 ft. |
| Wet excavation..... | 470.35 to 428.10 | 42.25 ft. |
| Pneumatic excavation. | 428.10 to 361.99 | 66.11 ft. |

The water elevation at the time of seal was 466.77, with the river falling. The final hydrostatic head was 104.78 feet, with a theoretical pressure of 45.5 pounds. A matter of 47.5 pounds was carried in the chamber up to the day of the seal when it was run up to 49 pounds while concrete was being placed.

Both of the shafts are now in the coal. The concrete tipple at the auxiliary shaft was ready for the cage on September 15; and at the main shaft, designed for a skip, the bottom bin excavation, concreting, etc., was completed early in November. The water in both shafts has been practically shut off and, with the final grouting, should be reduced to such a point as to make a pump on the bottom unnecessary.

This work has been carried out under the direction of E. Nesbit, chief engineer of the Grasselli Chemical Co., with the Allen & Garcia Co., engineers of Chicago, Ill., on the job.



*The blow pipe in action. At this stage in the operations dry sand was raised pneumatically from the working chamber through a 4-inch pipe by air at a pressure of nineteen pounds.*

The design of the caisson and working methods were planned by the Dravo Contracting Co., of Pittsburgh, Pa., with A. J. Hippert in charge of the field operations for the contractor.

## RESPIRATORS FOR MEN ON LOCOMOTIVES

MOST DISTRESSING in many cases must be the experiences of engineers and firemen on locomotives hauling freight trains through long tunnels. The cab fills with a hot and sulphurous mixture of air and smoke and exhaust steam, entailing much discomfort. Technical Paper 292, of the Bureau of Mines, tells of experiments conducted in 23 tunnels of the Baltimore & Ohio to devise means of relief. Gas masks of various types were worn by the experimenters in the cabs and by the engine crews, and samples of the atmospheric mixtures were analyzed in the Pittsburgh laboratories—the investigations being described in detail in the paper.

A pocket canister or respirator has been developed which will largely alleviate the discomforts and actual dangers. These canisters, which fit conveniently into a coat pocket, are filled with an absorbent mixture of activated charcoal and soda-lime, and contain filters of Turkish toweling. They have had the hearty approval of the men who have used them, and they retain their effectiveness for months.

Yugoslavia is now using American-made money. The new 10-dinar notes, being put into circulation by the National Bank, were designed and printed in the United States. One banker states that the country has never before had bank-notes of such excellence.

# The Pneumatic Paving Breaker and the Portable Compressor Win Recognition in London

By O. C. McINTOSH

IT HAS BEEN said that the London roads and streets, taking them generally throughout the city and boroughs, are the finest in the world, and they have been built at great cost and improved upon as the city extended.

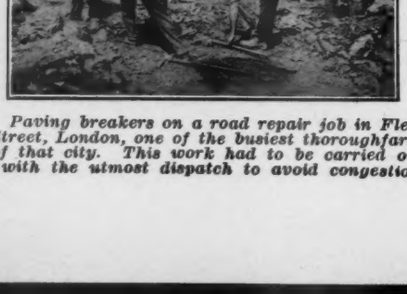
Owing to the heavy traffic on the main arteries, it was necessary to put in a very thick and substantial sub-base of concrete. In many places this was a four to one mixture, and some of it has been down for fifty years. Concrete at this age becomes as nearly perfect and tough as nature and time will make it.

Prior to 1921, all concrete which had to be taken out in order to lay new gas and water mains, post-office and lighting cables, was removed by hand labor. The practice was for four stalwart navvies, with large sledges, to hammer upon a 2-inch wedge held by a fifth man. This method, although picturesque, was very slow and expensive, and thereby concrete of this nature, sometimes twelve inches in thickness, cost as much as fifteen shillings per cubic yard to get out.

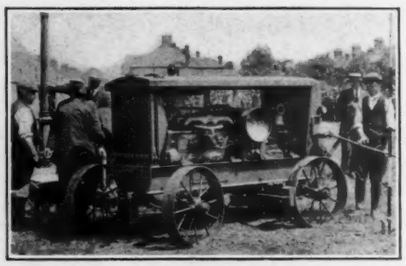
When the concrete on Commercial Road, which is the main highway from the Port of London to the City of London, had to be taken out in sections for the testing and the re-calking of the gas mains, it was found that this concrete, in places, was as thick as 28 inches. It was then that the Gas Light & Coke Co., of London introduced "Jackhamers" to assist in the work.

To get at the joints, they broke out every twenty feet a section eight feet long and four feet wide and drilled 1-inch holes about eight inches apart through the concrete. Then, by the use of plugs and feathers, they broke it out with sledges and hammers. Formerly, it took a gang eight to twelve hours to clear a space of this size in concrete eighteen inches thick, but with one "Jackhamer," type "BBR," a crew of the same number can do the work in from two to three hours.

The first big job on which an Ingersoll-Rand "CC-25" concrete breaker was used in London was at New Bridge Street, near Blackfriars Bridge. This job attracted a good deal of attention from all classes of people. Engineers came to see it for information; workmen watched it for various reasons; and one spectator remarked "Another job gone west, they ain't goin' to need no navvies no more." At first, labor as a whole did not take kindly to the innovation, but when they saw the tremendous advantages, and the ease with which the work was done, they soon became quite satisfied to use the pneumatic tools, and would now be surprised if they were called upon to work for any big contractor with the old-fashioned sledges.



*Paving breakers on a road repair job in Fleet Street, London, one of the busiest thoroughfares of that city. This work had to be carried out with the utmost dispatch to avoid congestion.*



*Portable compressor supplying energy to the paving breakers and pneumatic scoops used on the work of extending London's underground railway.*

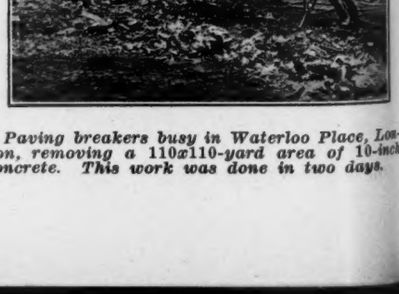
Another big job in London was the re-paving of Fleet Street from the entrance of the City up Ludgate Hill to Saint Paul's Cathedral. This job created a record for speed, and, according to the engineers in charge, it would have taken twice as long to do the same amount of work by the old method, putting on as many men as could possibly work in the available space. But one 8x8-inch Ingersoll Rand portable compressor was used in conjunction with four concrete breakers.

Speed was an essential factor, as these two streets, which are the main motor omnibus routes from Westminster to the City, are as greatly crowded with traffic as any in London. Therefore, congestion occurring during repairs would have caused serious delays, which might have led to extra expense to the taxpayer both through loss of time and the cost of additional traffic controllers. The use of compressed air on this job therefore doubly justified itself.

Concrete breakers have also been most successfully employed for breaking out granite sets, using a standard bit with a flattened chisel edge. In the Borough of Stepney, London, some granite sets, which had been in for many years, were so tightly packed with cement that they could not be gotten out with hammers and wedges without breaking 90 per cent. of them: as a matter of fact it was impossible to see where one set commenced and the other ended. This also was a very slow and an exceptionally hard task. By using concrete breakers not only were the sets freed much more quickly but 50 per cent. of them were saved. Operations were made rather difficult because the trenches for the laying of single cables were only fifteen inches wide, and in such a narrow space work is necessarily slowed up. The contractor who was in charge of the job, which was about a mile in length, reported that he not only completed the contract much under the time limit specified but that he would not have been able to do this by hand methods. The cost of the job was 50 per cent. of what it would otherwise have been.

One of the most interesting jobs done in England was at Waterloo Place, Westminster, London. At that spot there was an area about 40 yards long and 40 yards wide, and the concrete, which was of medium quality, averaged approximately nine inches in thickness. A prominent London contractor put in two 8x8-inch Ingersoll-Rand portable compressors and ten "CC-25" concrete breakers; and in eighteen hours' working time he broke out with this equipment substantially 420 cubic yards of concrete. But ten men were employed to do the actual breaking. The cost came to about two shillings per cubic yard, including all charges for fuel, supervision, interest on the investment, etc. This was a splendid performance, and everyone concerned was highly pleased with the results.

Portable compressors and concrete breakers are now a common sight throughout London; and to-day there are about ten of these outfits at work in different parts of the city. They still continue to attract large crowds when operating where they have not been in use before; but, broadly speaking, the novelty has worn off and the general public has lost interest in the pneumatic equipment now that it has proved its usefulness. On the other hand, city engineers and contractors realize that by taking advantage of modern compressed air machinery for municipal improvements of all kinds they are not only making a good investment themselves but benefiting the overburdened taxpayer as well.



*Paving breakers busy in Waterloo Place, London, removing a 110x110-yard area of 10-inch concrete. This work was done in two days.*

# An Impressive Example of Progress in the Manufacture of Ice

## Description of the Plant of the City Ice Company, Easton, Pa.

By SIDNEY MORNINGTON

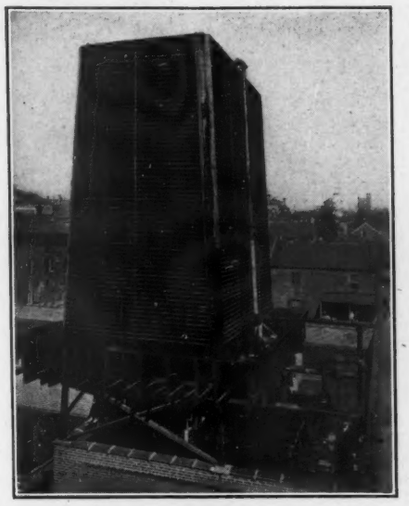
MANUFACTURED ice is steadily growing in importance for refrigerating purposes primarily because the man-made product is absolutely independent of weather conditions. Even where climatic conditions favor the annual forming of ice upon natural bodies of water, the character and the quantity of the ice are determined by the severity and the length of the periods of low temperature. Time and again the normal supply from such sources has either failed or been insufficient to tide those relying on it over the much longer range of the mild or the warm months of the year. This has led to wide fluctuations in price and, not infrequently, to a good deal of inconvenience and, perhaps, discomfort to a great many people.

Again, the iceman's business has been full of uncertainties whenever he counted entirely upon freezing weather to furnish him with a harvest ample enough to meet the accustomed needs of his trade. In other words, he has had to carry a fairly fixed overhead in the way of storage facilities and distributing equipment, and he could never be sure that his ultimate balance would be on the favorable side of the ledger. The public is always impatient when it cannot get what it wants, and the iceman has repeatedly been abused when Nature was really responsible. These facts are mentioned in order that we can appreciate why artificial ice is growing in favor in an industry which has become indispensable to the comfort and to the well-being of many millions of our population.

Finally, let it be said that manufactured ice from a hygienic point of view is generally superior to natural ice, because the water supply in the former case can be controlled or dealt with in a way to insure its purity. This is a matter of the utmost importance to the consumer.

One of the most recent additions to the ice industry in the East is the new 60-ton, electric-driven plant lately completed for the City Ice Co., of Easton, Pa. This establishment is so situated that delivery can be made readily therefrom to any part of the town. The plant represents the most up-to-date practice in the making of raw-water ice, and is especially distinctive inasmuch as it is the first ice plant to use compound compression for the manufacture of ice alone. As the City Ice Company already had its own delivery system, the new building was erected alongside of the existing offices and stables.

Van Rensselaer H. Greene, refrigerating engineer and architect, has been responsible for the structure and for the arrangement of the refrigerating installation in their entirety, and their erection was carried out under his supervision. The plant has been so planned that its capacity can be increased another 60 tons in the near future, which will enable it to turn



*The cooling tower is of special design and surmounts the coils of the ammonia condenser.*

out daily a total of 120 tons. The building is of brick, with concrete roof and beams. The beams supporting the roof over the present ice tank-room are of sufficient strength to bear the floor for the second tank-room. Steel sash windows are provided throughout, and these windows are of generous dimensions so as to insure satisfactory ventilation and a plenty of natural light.

Under existing conditions, the storage room can accommodate 500 tons of ice, but by standing the cakes up on end and by stacking them to a greater height it is practicable to augment the storage capacity considerably. Space is left in the engine-room for the installing of additional units. A large paved yard makes it easy for wagons or trucks to load at the bridge.

Now let us consider the details of the refrigerating equipment. The ammonia condensers are located on the roof over the engine-room, and their foundations are capable of carrying the additional condensers which will be required later on. Above the present condensing coils is erected a cypress cooling tower of special design which forms an integral part of the building.


*From the storage room the blocks of ice are slid onto the platform from which the distributing wagons are loaded.*

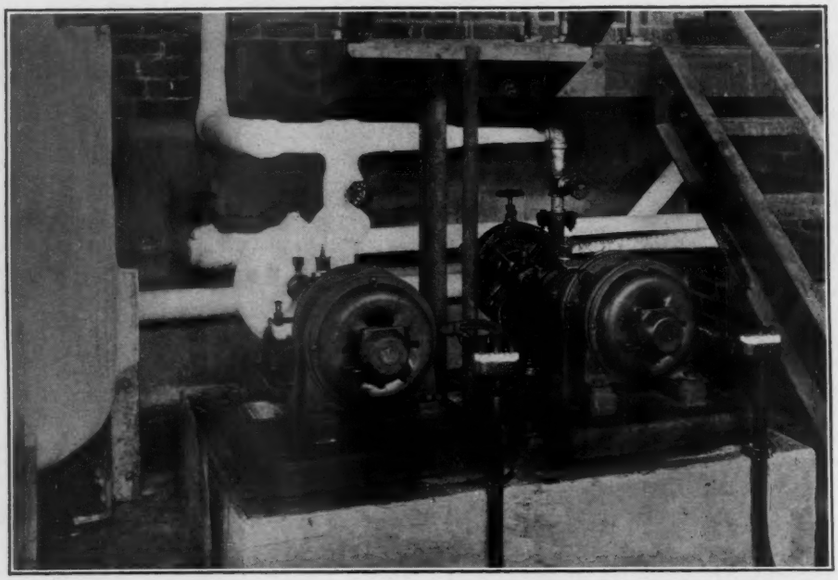
The primary refrigerant is ammonia, and is circulated by an Ingersoll-Rand, 2-stage, ammonia compressor which is driven by a direct-connected, high-speed, synchronous motor. This compressor is a 13x9x14-inch unit of the "XREA-2" type, with hand-operated clearance pockets for unloading to 50 per cent. capacity when running below normal full-load conditions. By-pass valves are also provided on the high and the low pressure cylinders for unloading during the starting period. The machine runs at 225 revolutions per minute, with a suction pressure of twenty pounds and a discharge pressure of 185 pounds. Under these conditions the compressor will deliver 388 cubic feet per minute actual capacity, or have a refrigerating output of approximately 113 tons.

A water intercooler between stages is placed directly below the cylinders, making a very compact arrangement and avoiding the employment of additional piping. Water from the cooling tower circulates first through the intercooler on the machine and then passes on to and over the ammonia condensers. Make-up water is obtained from the city mains. A General Electric self-starting, synchronous motor of 185 H. P. is direct connected to the ammonia compressor and operates on a 2,200-volt, 3-phase, 60-cycle circuit and with a belt-driven exciter.

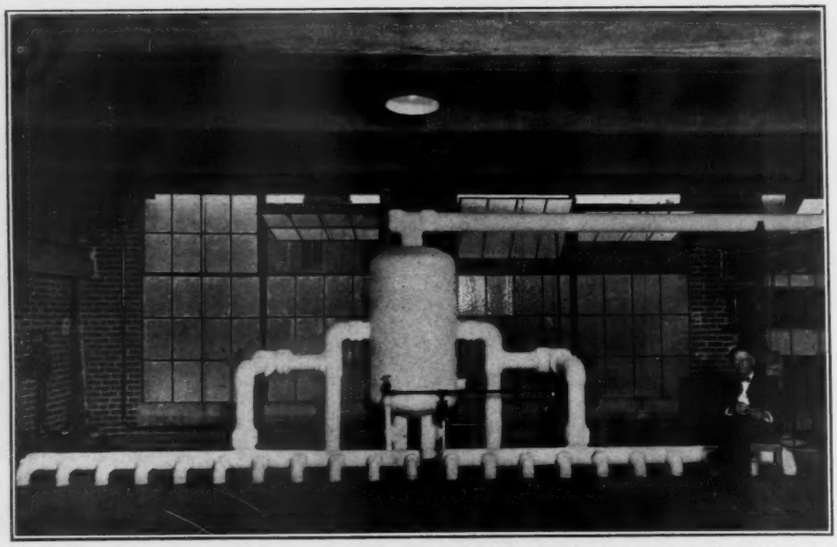
The make-up water, referred to in the foregoing paragraph, is taken care of by two centrifugal pumps—one being in service while the other is held in reserve. These pumps are of the Cameron double-suction impeller, horizontally split casing type which has a capacity of 350 gallons per minute. Each pump is direct connected to a 10-H. P., 220-volt, 3-phase, 60-cycle, Westinghouse motor.

The ammonia condensers are of the atmospheric bleeder type, and were built by the Superheater Company. They are made up of twelve stands of piping, twelve pipes high, and are of continuous weld construction. By thus avoiding the use of threaded joints leakage of ammonia is prevented. A special arrangement is provided by which the purging of the condensers can be effected whenever desired.

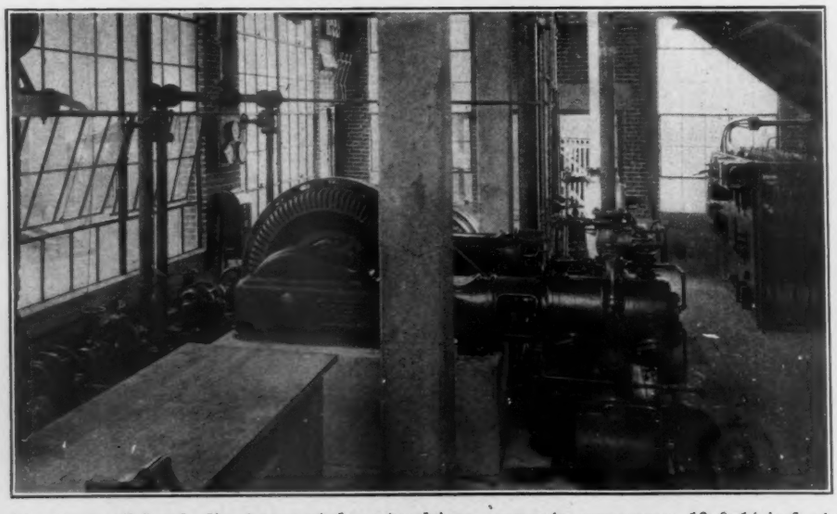
Two Ingersoll-Rand compressors supply the air for agitating the water in the cans so as to insure clear and solid cakes of ice. But one of these compressors is used at a time—the other constituting a spare. These compressors are 12x8-inch units of the belt-driven "ER" type, and each is operated at 250 revo-



*The two Cameron pumps, direct connected to 3-H. P. motors, which draw cold brine from the freezing tank and deliver it to one of the elements of the air-drying system.*



*The accumulator and the headers of the coils of the freezing tank through which the refrigerating ammonia is distributed. The accumulator serves as a trap to catch any oil which may be carried over from the compressor by the gaseous ammonia.*



*The Ingersoll-Rand, direct-connected, motor-driven, ammonia compressor, 13x9x14-inch stroke, which handles the primary refrigerant for the plant.*

lutions a minute by a 25-H. P. Westinghouse motor energized by a 220-volt, 3-phase, 60-cycle circuit. Air flows from the compressor to an air receiver located in the engine-room and thence to a coil lying in the condenser pan. From the latter, the air is led to a special drying apparatus where the temperature is lowered to a point that insures the complete precipitation and removal of any lingering moisture. This is a matter of moment because any moisture in the piping of the air-agitating system might lead to the clogging of the lines at a critical stage and occasion serious losses in the output of ice. The agitation is effected by air at what is termed medium pressure, that is, anywhere from 30 to 40 pounds per square inch.

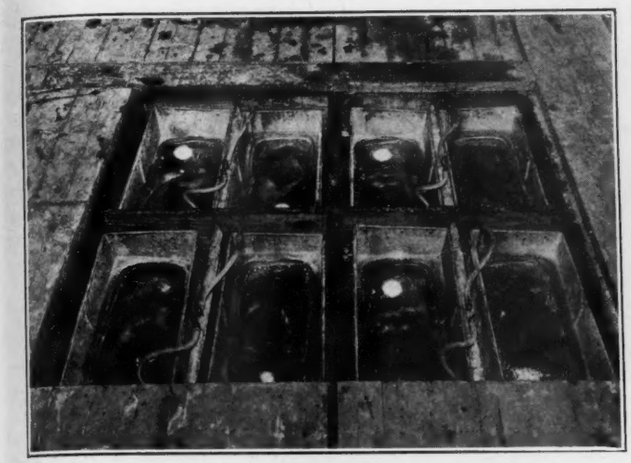
As a matter of information, it might be interesting to mention here that the first stage of air drying is accomplished by water cooling, while the second and last stage involves cooling the air by cold brine. The brine for this purpose is drawn from the ice tank, and is pumped by one or the other of two small Cameron centrifugal pumps to the so-called brine air drier. The refrigerant is salt brine.

The switchboard for the plant is of the well-known General Electric make, and is composed of four panels. One of the panels is for the incoming line, one for the control of the ice machine, and one contains the necessary circuit feeders, while the fourth panel, which is to take care of the second ammonia compressor to be installed later, is at present blank. The switchboard is complete in every detail and is provided with the necessary instruments, potential and current transformers, etc. An important feature is the provision of two curve-drawing wattmeters: one for the recording of the total kilowatts for the whole plant and the other for registering the consumption of the auxiliary apparatus. The auxiliary load and lighting are taken care of by three General Electric 37½ K. V. A., 2,200-volt primary, 110/220-volt secondary, single-phase transformers. Power is furnished by the Pennsylvania Edison Co., Easton, Pa.

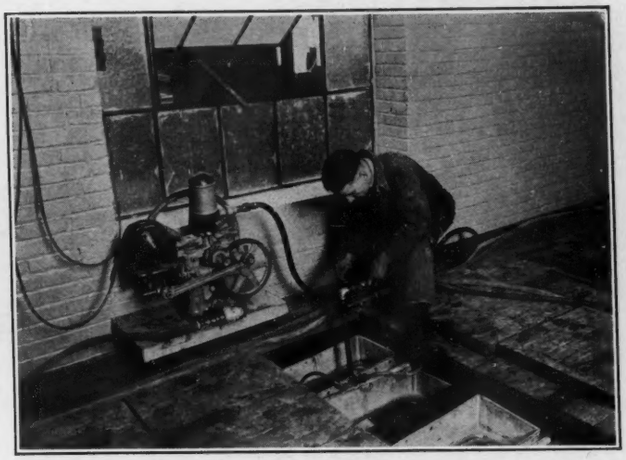
The ice tank is of the flooded type, carefully insulated, containing 840 cans, each of which has a capacity of 300 pounds. A period of 48 hours is required to effect the freezing of the water in a can. A motor-driven crane serves to harvest the ice; and it is capable of handling four cans simultaneously. The plant was started up on the 1st of October, and between that date and the 2nd of November there were "pulled" 10,956 cakes.

At one end of the ice tank are installed the headers and the accumulator of the ammonia system. The accumulator has a special and a very efficient arrangement for taking care of any oil which may be carried over from the compressor by the ammonia. In other words, the accumlator performs the function of a trap; and by removing any lubricant it safeguards the refrigerating coils in the ice tank from the intrusion of foreign matter which might obstruct them. As this end of the ice tank-room opens directly into the engine-room the installation is such as to render it easy for the engineer to keep an eye on the expansion valves, etc. The circulation of the brine in

# VARIOUS STAGES IN THE PRODUCTION RAW-WATER ICE

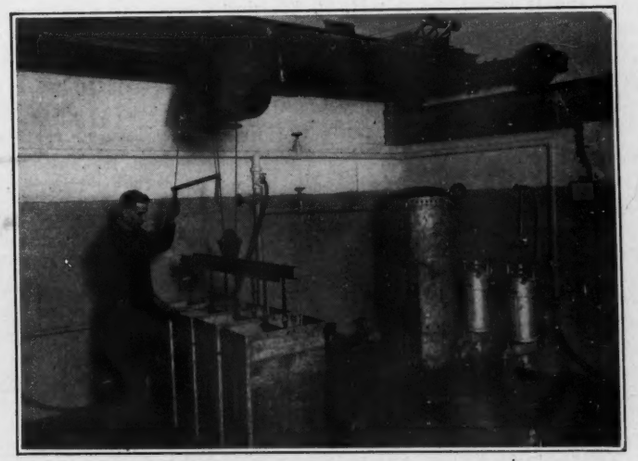


*Water in cans, just beginning to freeze around the sides, vigorously agitated by submerged jets of compressed air.*



*A core pump serves to withdraw water carrying sediment from forming blocks of ice and to refill the cavity with clear water.*

*The agitation of the water by compressed air is continued until the blocks of ice are completely formed. Air bubbles are plainly visible.*

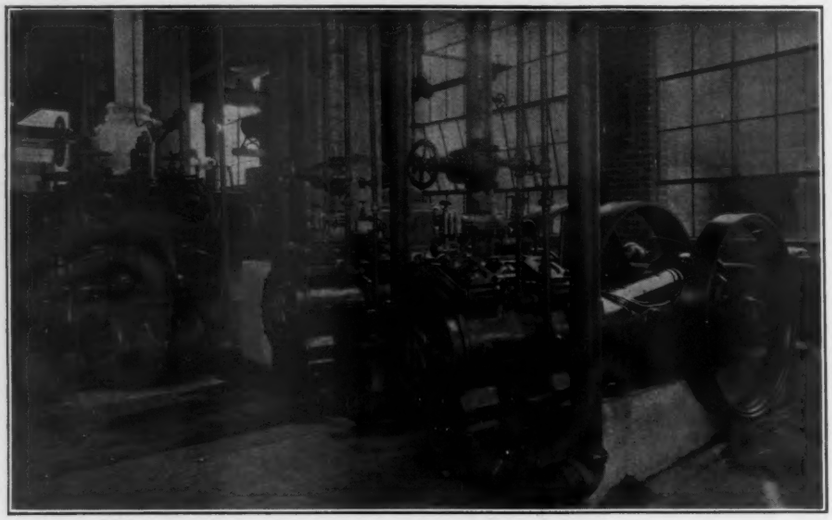


*Lowering a group of tanks into the dipping well to loosen the blocks of ice. At the right is the Lava Filtrine installation which filters the water.*

*Air agitated the water for the upper block during the whole freezing period and produced a compact, clear cake. The lower block was frozen without air agitation and the ice is white and spongy.*

Photos, Courtesy of City Ice Co.

*Lifting cans of ice from freezing tank. Each block of ice weighs 300 pounds. Four cans are handled at a time.*



*A view of the engine-room. The ammonia compressor in the distance and the two 12x8-inch, Class "ER" compressors close up which furnish the air for agitating the water during freezing.*

the ice tank is induced by the thrust of a 22-inch, 3-blade propeller. This propeller is mounted on a horizontal shaft piercing the tank wall in the neighborhood of the accumulator, and is driven by a 5-H. P. Westinghouse motor.

The thawing, the dumping, and the can-filling apparatus are at the opposite end of the tank-room, and were designed by Mr. Greene. The dump deals with four cans at a time, and is so mounted on special swivels that each can can be tilted separately, which makes it easy for one man to handle. An automatic can filler is situated over the ice dump, and as soon as the ice has been discharged from the cans this equipment fills them at a single operation with the proper amount of water. To facilitate the removal of the ice, each group of loaded cans is dipped for a few minutes in a well of warm water before the cans are moved to the dump. A Jamison automatic ice chute is able to take four cakes at a time and to pass them from the dump directly into the ice storage room.

Because of the comparatively short while that the City Ice Company's plant has been running, it is not possible to arrive at any definite conclusion as to the probable power consumption until the installation has been thoroughly tuned up. However, due to the continuance of warm weather during the interval mentioned and the sustained demand for the commodity, the equipment has been working at full capacity, and the records show that the plant has produced daily 66 tons of ice. This ice has been made at an expenditure of 51 kilowatt-hours per ton. Of this current consumption, eleven kilowatt-hours per ton were utilized by the auxiliary load. These figures are suggestive inasmuch as they indicate a considerably larger yield of ice in actual practice than was expected—in short, the output has been 10 per cent. more than the estimates promised. This performance is evidence of the increase in efficiency, therefore economy, made possible by the adoption of the compound ammonia compressor.

*The ice dump from which the frozen blocks are run into the storage room. As soon as the cans are emptied they are filled with measured quantities of water from the reservoir overhead.*

## THE BEAR MOUNTAIN BRIDGE

A BRIDGE to cross the Hudson, and which presumably will be named Bear Mountain Bridge, will soon be a reality, the contracts having been placed for its construction. As it is largely and necessarily a compressed air job we cannot fail to be interested. It will be one of the longest, if not the longest of the suspension bridges in the United States, connecting Bear Mountain with Anthony's Nose. The roadway of the bridge will be 200 feet above the river and the towers will be 400 feet high. The location of the bridge is in perhaps the most magnificently picturesque spot in the Empire State, commanding impressive vistas both up and down the river in the very heart of the highlands of the Hudson.

It will be a toll bridge, principally for automobile traffic; and much rock cutting and grading will be required in the preparation of the approaches and the connecting highway, especially on the east side of the river.

## A BOLL WEEVIL CATCHER

A PROBLEM almost of life or death to the cotton-growing industry of the United States is that of delivery from the boll weevil. That insect is capable of practically destroying the entire crop, and various devices are being tried, but none with decisive success. Spraying the fields with poisonous liquids gives no satisfaction, and dust spraying is said to be a little better. Perhaps the most promising scheme in sight is one with a pneumatic feature, although the proposition is a bold one. It is to attract, to catch, and to destroy the nests of moths as they arrive to begin their depredations. A college student, James E. Cross, of Kenton, Tenn., has designed the apparatus for the protection of his father's plantation. That it does the business is sufficiently evidenced by the fact that it has trapped from ten to fifteen bushels of weevil moths in a single night.

Little description is required to make the functioning of the apparatus plain. A wide-reaching searchlight attracts the winged pests to the source of light, and then a suction fan draws them, with no possibility of return, down an upright tube into an enclosed box.

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We are advised by the United States Department of Commerce that since the discovery of America, in 1492, something like 875,000,000 fine ounces of gold, valued at $18,000,000,000 have been produced in the world. About $8,000,000,000 worth of it is in the form of money, which is in circulation or deposited in banks or public treasuries throughout the various nations, and of this sum one-fourth or $2,000,000,000 is in the Treasury of the United States. The other $10,000,000,000 worth of gold has been used up in the industrial arts or has disappeared in the 43 decades that have passed since accurate gold statistics were regularly kept.

## SAVING OF DRILL STEELS

*By C. C. HANSEN*

WHEN MAKING up drill steels from bar stock, it is very important to know the exact cutting-off lengths of each different length of steel and bit so that the bar stock can be worked up with the least amount of waste from ends of the bars that are so short that no steels can be made from them. Bars of drill steels in random lengths will run all the way from seventeen feet to 22 feet; and with the accompanying table it should be comparatively easy to select bars and lengths of steel that would cut up the bar with a maximum waste of only a few inches.

In the following table is given, for the different sections of steel, the material required for making existing standard shanks. There is also given the amount of material needed for making up the different bits of varying diameters for the different sections of existing drill steels.

To make the table and the foregoing clearer, there are added a few examples of existing steels that show how the different lengths are figured out.

By marking the desired lengths on the sticks, the blacksmith can go over his bar stock and will be able to select such stock as will give him the minimum amount of waste for the length and quantity of steel to be made up.

The existing commercial drill steel should never be forged at a lower temperature than 1,800° F. and not above 1,950° F. Never harden shanks or bits from forging temperature, but after forging allow steel to lie in a dry place until quite cool.

Harden shanks in soluble quenching oil (Houghton No. 2 Soluble). After steel has cooled off from forging heat, reheat shank from eight to nine inches in length to a temperature of from 1,470° to 1,550° F., and quench in soluble quenching oil. Shanks should never be so hard that they cannot be filed with a new sharp file

To harden bits after forging, and after the steel has been cooled off from forging temperature, reheat from 1,460° to 1,500° F., and quench in pure, running water. In quenching the bit for hardening, it should never be submerged entirely in the water but should be held to a depth of from ½ inch to ¾ inch evenly around the cutting edges of the bit until the heat is entirely dissipated.

Proper blacksmithing and proper hardening of drill steels mean more work but less breakage, and are, therefore, very important facts to be considered.

### CUTTING OFF LENGTH FROM BAR STOCK TO FORM DRILL STEEL WITH SHANK AND BIT

| Drill Steel Section. Hollow and Solid Hex. Round. Octagon or Cruciform | Drilling Length | SHANKS: Length of steel required for Shank and for Forging Shank | | | | | | FOR CROSS AND CARR BITS: DIAMETER OF BIT (in inches) — LENGTH OF STOCK (in inches) FOR FORGING BIT | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3¼" Jack Hammer Shank | 4¼" Jack Hammer Shank | Leyner Lug Shank | Stoper Steel Allow for Shank | Piston Drill Steel: With Shank | Piston Drill Steel: Without Shank | 1⅛ | 1¼ | 1⅜ | 1½ | 1⅝ | 1¾ | 1⅞ | 2 | 2⅛ | 2¼ | 2⅜ | 2½ | 2⅝ | 2¾ | 2⅞ | 3 | 3⅛ | 3¼ | 3⅜ | 3½ | 3⅝ | 3¾ | 3⅞ | 4 |
| 7/8" | + | 7 | 8 | | 6 | 4¾ | 5 | ⅜ | ⅝ | ⅞ | 1½ | 2 | 2½ | 3⅜ | 4⅛ | 5¼ | 6¼ | 8¼ | 10¼ | 12¼ | 14¼ | 16 | 17 | | | | | | | | |
| 1" | + | 6¾ | 7¾ | 8 | 6 | 5¼ | 5½ | | ⅜ | ⅝ | ⅞ | 1⅛ | 1⅜ | 1¾ | 2 | 2⅜ | 3¼ | 4¼ | 4¾ | 6 | 7¼ | 8¼ | 9 | | | | | | | | |
| 1⅛" | + | | 7⅝ | 7⅝ | 6 | 5¾ | 6 | | | | ¾ | 1 | 1¼ | 1½ | 1¾ | 2 | 2½ | 3⅛ | 3⅝ | 4⅜ | 5½ | 7½ | 8¼ | 9 | 10 | | | | | | | |
| 1¼" | + | | | 7½ | 6 | 5¾ | 6 | | | | | ½ | ⅝ | ¾ | 1 | 1¼ | 1½ | 1¾ | 2¼ | 3¼ | 4 | 5 | 5¾ | 6½ | 7¼ | 8¾ | 10¾ | 13 | 19 | 20 | 21 |
| | | | | | | | | FOR 6 POINT ROSE BIT — LENGTH OF STOCK (in inches) FOR FORGING BIT | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7/8" | | | | | | | | ½ | ⅞ | 1¼ | 1⅞ | 2⅛ | 3¼ | 4¼ | 5¼ | 6⅝ | 8¼ | 9½ | 12 | 15⅛ | 17¼ | | | | | | | | | | | |
| 1" | | | | | | | | | ½ | ¾ | 1⅛ | 1½ | 1¾ | 2¼ | 3 | 3¾ | 4¼ | 5¾ | 7 | 8⅝ | 9⅝ | 10¾ | 11½ | | | | | | | | | |
| 1⅛" | | | | | | | | | | | ⅞ | 1⅛ | 1½ | 1⅞ | 2⅜ | 2⅝ | 3¼ | 3⅞ | 4¾ | 6½ | 7½ | 8¼ | 9 | 10¼ | 12 | | | | | | | |

*To find bar stock (cutting off length) required for any length of Drill-Steel, add to the "Drilling Length" (2', 4', 6' etc. or 1', 2', 3' etc.) the amount given in table for Shank, and for the size of Bit required. The sum is the cutting off Length of Bar Stock.*

For an eight-foot set of 1¼-inch hollow, round, "Leyner," lug steel, 2-feet run, we find, according to the table, that a 1⅝-inch diameter bit is the smallest practical bit to use with 1¼-inch hollow, round steel.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | ft. | diam. | bit | 2 | in. | = | 2 | ft. | plus | 7½ | in. | plus | 1 | in. | = 2 ft. | 8½ in. cut-off length. |
| 4 | " | " | " | 1⅞ | " | = | 4 | " | plus | 7½ | " | plus | ¾ | " | = 4 " | 8¼ " " " |
| 6 | " | " | " | 1¾ | " | = | 6 | " | plus | 7½ | " | plus | ⅝ | " | = 6 " | 8⅛ " " " |
| 8 | " | " | " | 1⅝ | " | = | 8 | " | plus | 7½ | " | plus | ½ | " | = 8 " | 8 " " " |

For a 6-foot set of ⅞-inch hollow, hexagonal, "Jackhamer" steel, 3¼-inch "Jackhamer" shank, 12-inch run, we find that 1⅛-inch diameter is the smallest practical bit to be used with ⅞-inch hollow, hexagonal steel.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ft. | diam. | bit. | 1¾ | in. | = | 1 | ft. | plus | 7 | in. | plus | 2½ | in. | = 1 ft. | 9½ in. cut-off length. |
| 2 | " | " | " | 1⅝ | " | = | 2 | " | plus | " | " | plus | 2 | " | = 2 " | 9 " " " |
| 3 | " | " | " | 1½ | " | = | 3 | " | plus | " | " | plus | 1½ | " | = 3 " | 8½ " " " |
| 4 | " | " | " | 1⅜ | " | = | 4 | " | plus | " | " | plus | ⅞ | " | = 4 " | 7⅞ " " " |
| 5 | " | " | " | 1¼ | " | = | 5 | " | plus | " | " | plus | ⅝ | " | = 5 " | 7⅝ " " " |
| 6 | " | " | " | 1⅛ | " | = | 6 | " | plus | " | " | plus | ⅜ | " | = 6 " | 7⅜ " " " |

For an 8-foot set of stoper steel, 1-inch solid hexagonal, 12-inch run, we find that 1¼-inch diameter is the smallest bit to be used on 1-inch hexagonal steel.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ft. | diam. | bit | 2⅛ | in. | = | 1 | ft. | plus | 6 | in. | plus | 2⅜ | in. | = 1 ft. | 8⅜ in. cut-off length. |
| 2 | " | " | " | 2 | " | = | 2 | " | plus | 6 | " | plus | 2 | " | = 2 " | 8 " " " |
| 3 | " | " | " | 1⅞ | " | = | 3 | " | plus | 6 | " | plus | 1¾ | " | = 3 " | 7¾ " " " |
| 4 | " | " | " | 1¾ | " | = | 4 | " | plus | 6 | " | plus | 1⅝ | " | = 4 " | 7⅜ " " " |
| 5 | " | " | " | 1⅝ | " | = | 5 | " | plus | 6 | " | plus | 1⅛ | " | = 5 " | 7⅛ " " " |
| 6 | " | " | " | 1½ | " | = | 6 | " | plus | 6 | " | plus | ⅞ | " | = 6 " | 6⅞ " " " |
| 7 | " | " | " | 1⅜ | " | = | 7 | " | plus | 6 | " | plus | ⅝ | " | = 7 " | 6⅝ " " " |
| 8 | " | " | " | 1¼ | " | = | 8 | " | plus | 6 | " | plus | ⅜ | " | = 8 " | 6⅜ " " " |

Invitations have been issued by the Federal Council to the Saar Commission and to all those countries that are members of the International Union for Railway Transportation—as well as to some that are not members—to meet at Berne, Switzerland, on May 1, 1923. This railway conference, which was originally called for the spring of 1915, will discuss various plans of revision as well as amendments governing the transportation of passengers and baggage. The countries interested are requested to inform the Federal Council of any proposals which they desire to make.

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The Gulf District of the United States ranks second to the North Atlantic District in importance as a transportation center as it provides an outlet for over 26 per cent. of the exports and receives over 30 per cent. of the imports, including oil cargoes, of the entire country.

## A PORTABLE JOURNAL TURNING MACHINE

AN INGENIOUS, portable, air-driven machine has been devised by Claude E. Marsh of Atlanta, Ga., which can be used at terminals and at division points where there is no shop equipment capable of handling heavy running repair jobs such, for instance, as turning rough or cut journals, crank pins, etc. The new apparatus is able to do work of this sort in a way which does not call for the customary withdrawal of a locomotive from active service.

The usual equipment for journal-turning work is a 90-inch lathe. Such a machine is costly, it requires large floor space, and is expensive to operate inasmuch as it takes from 25 to 50 H.P. to drive it. Terminals or division points between the main shops do not have, as a rule, enough journal-turning or other heavy work to justify the outlay for a 90-inch lathe. When a locomotive journal, on account of lack of lubrication or some other condition, makes it necessary either to turn the journal or to withdraw the locomotive from service, it is the common practice then to drop the wheels, to remove them from under the engine, to load them on a car, and to ship them to the nearest shop that is able to handle the task. This not infrequently means the loss of a week's time before the locomotive is again fit to earn money for the company.

The Marsh machine is designed to overcome delays of this sort. It is a comparatively inexpensive equipment, simple in its make-up, substantial in construction, and can be handled by any mechanic. It is said that it will do the work quicker than any other machine; and that it will save all labor costs except those for the mechanic who operates it. The inventor explains that with his equipment it is not necessary to remove the wheels and axle from under a locomotive, to send them to a machine shop to be put in a lathe to be turned, and then to return them to the roundhouse where they may be placed again beneath the engine. The journal-turning machine is attached directly to the axle, and, with the aid of a No. 2 "Little David" drill, non-reversible type, a journal can be turned more expeditiously than the work can otherwise be done.

To apply the journal-turning machine, which, by the way, is made in halves, the operator withdraws the bolts on each side of the apparatus, fits the halves to the axle to be turned, and holds it there by resetting and tightening the bolts. The outfit is then as solid as though made of a single piece. The machine is clamped onto the axle by turning an adjusting ring, at the end of the device, and this action operates the four universal chuck jaws that secure the machine and center it on the axle. Finally, the tool holder is placed in the machine; the cutting tool is set; the "Little David" drill is coupled up; the air line is opened; and the turning of the axle begins. The period consumed in setting up should not exceed twenty minutes while the actual turning will be performed in about the same time as if done on a lathe.

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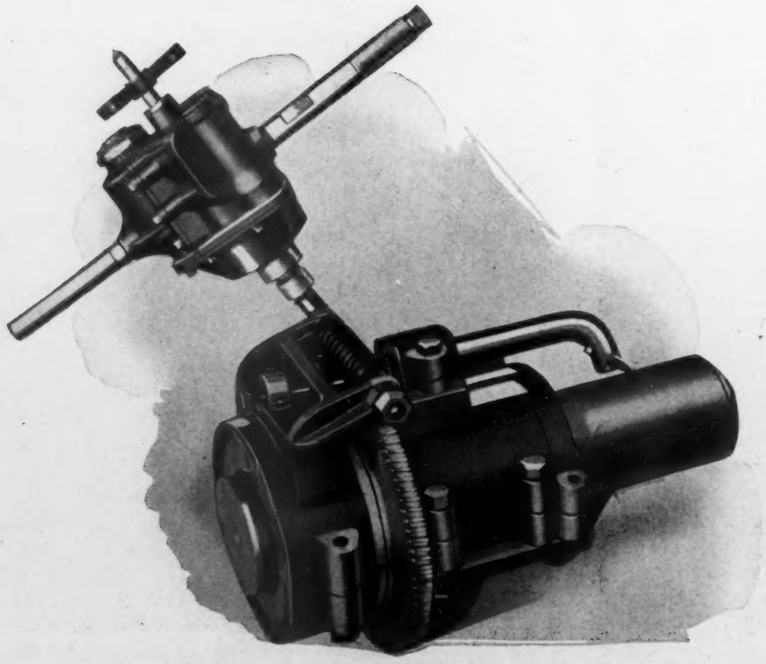
According to *Amexa News,* American manufacturers of machinery and of materials in demand in the Far East have been handicapped by the fact that industrial enterprises in China and the Orient generally have, as a rule, been financed by other nations, with the result that our people have been unable to bid on plants and equipments. In order to develop a market for American products there is being organized the Federal Pacific Banking Corporation, whose object is to assist in the selling of securities of Chinese and other Far Eastern enterprises whenever the capital is to be used in the purchase of American goods. It is claimed that this will not only help to create a market for our commodities but that it will also provide freight for the American merchant marine.



*The Marsh portable journal-turning machine.*

## COMPRESSED AIR DOES MUCH HELPFUL WORK IN A BANK

ONE WOULD hardly look for air compressors in a bank, and yet one of New York City's largest institutions of this kind has a number of such machines tucked away in a corner of the building for a variety of uses. One compressor is a part of the refrigerating plant, which produces a chilling effect equal to a daily supply of twenty tons of ice. In addition to keeping in fit condition the provisions that are required to run the restaurant maintained by the bank, it chills the drinking water supplied to numerous stationary fountains throughout the building and also furnishes ice for portable water-coolers.

The plant consists of an ammonia compressor, driven by a 30-H. P. motor, and of two brine pumps, actuated by 7½-H. P. motors, together with the necessary ammonia tanks, brine tanks, separators, and condensing coils. Experience has taught the bank that it is more economical to operate the refrigerating system than it is to buy ice.

Four additional compressors, also driven by 7½-H. P. motors, provide air for different uses. The bank in question destroys all retired notes, bonds, documents, records, etc., by burning them in a specially designed incinerator, which prevents even a tiny portion of a coupon, for example, from escaping through the flue. In order to assure perfect combustion of the papers —and a mass of papers, as we all know, is not readily destroyed by burning—a stream of compressed air is blown under the grates. As a precautionary measure against loss, the doors of the incinerator are locked as soon as it is charged, and the keys are then turned over to the proper officer.

There is an extensive pneumatic tube system in the bank which is controlled in a rather unique fashion. The speed of the 15-H. P. motor, which operates the system, depends on the demand for air in the central dispatch room. Compressed air is also used for sewage disposal, for the operation of thermostats, etc.

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## LIQUID AIR FOR MINE RESCUE APPARATUS

OWING TO THE recognized advantages of liquid air as a substitute for the free atmosphere, various attempts have been made to use it instead of oxygen in the different breathing apparatus employed for mine rescue work. Several such bags, designed to supply liquid air, have been submitted to the Mines Department of the British Board of Trade, but only latterly has an apparatus been devised that meets with the approval of that body.

The new breathing apparatus consists of a liquid air container, which is carried on the back, and of a breathing bag which rests on the chest and the stomach of the wearer. The two primary parts are connected in a suitable fashion by piping. Two short tubes, one carrying the inhale valve and the other the exhale valve, pass the air on to the mouth and vice versa. The capacity of the container is sufficient for two hours' use; and weighs when fully charged a matter of 38 pounds. One interesting feature of the equipment is that it enables a second man, by means of a very simple connection, to draw on the supply of liquid air.

# How the Rescue Work was Carried Out at the Argonaut Mine

## The Record of a Heroic Attempt to Save Life

By S. G. ROBERTS

**THE GRIM story of the Argonaut mine disaster has been told. The public generally knows that 47 workers were caught nearly a mile underground and suffocated by gases generated during the burning of the timber lining of the main shaft. But the story of the efforts made to succor the imprisoned men before they perished is not so well known.**

**We are able now to give a first-hand account of the experiences of one of the rescuing force. Although the valiant and self-forgetful labors failed of their primary purpose, to save life, still the record is an example of a staggering and hazardous job carried through within an astonishingly brief span when the difficulties that confronted those men are considered.**

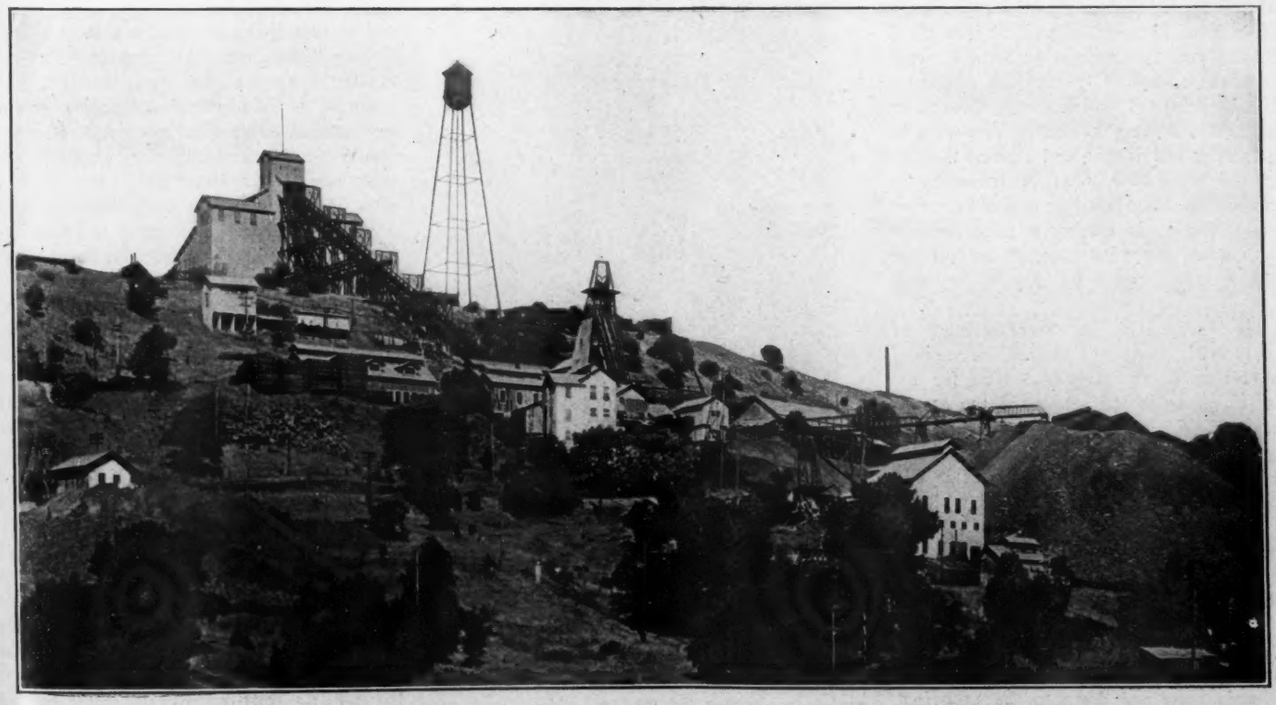
THE Argonaut mine is located about a mile northwest of Jackson, Cal., and is reputed to be one of the richest gold producers in the country. It has been worked for more than a quarter of a century, and the annual yield is somewhere around an average of $1,000,000 in value. In following the gold-bearing vein, the operators of the mine have sunk their main shaft to a depth of more than 4,800 feet, and from this shaft they have driven many drifts or horizontal passages in their quest for more and more of the precious metal.

In making their way into the bowels of the earth, the miners, as is a common practice, employed timber bracing to safeguard themselves against the collapse of the enveloping walls, and, paradoxically, it was this protective agency that promoted the recent catastrophe. The conflagration of portions of this reinforcement threw off the smoke and gases which asphyxiated the men caught far below the flaming area. The noxious fumes descended and got to the miners before they could effectually barricade their retreat against the deadly, penetrating atmosphere. They made a gallant fight, but the odds were overwhelmingly against them.

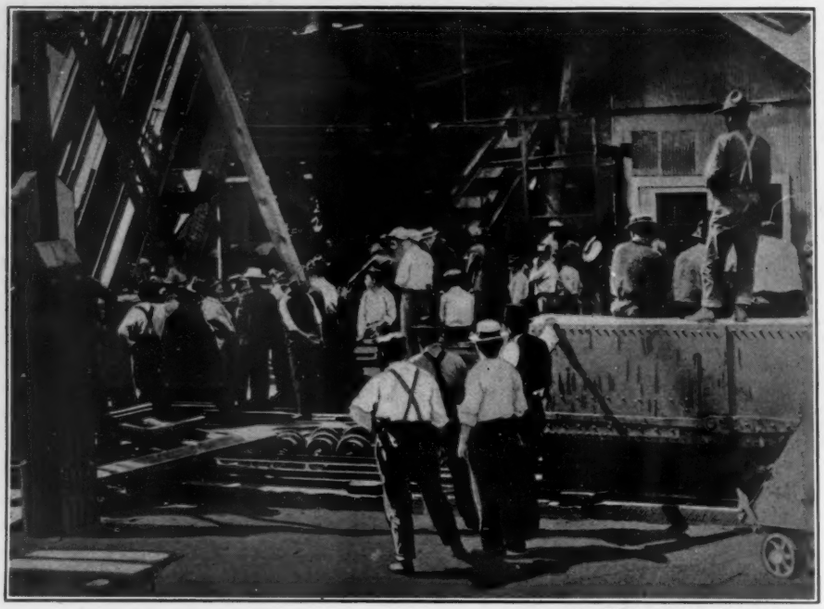
The fire was discovered just before midnight of the 27th of August and but a few minutes before the doomed shift was scheduled to cease work and to return to the surface. The blaze started in the neighborhood of the 3,000-foot level, and worked upward in the main shaft of the Argonaut. Strenuous but unsuccessful efforts were made to extinguish the fire with water. Failing in this, it was then decided to cut away two sets of timbers at the 2,700-foot level in order to make a gap in the woodwork and thus to deny the flames fuel upon which to feed. It might be mentioned here that the main shaft of the Argonaut mine was linked with the associate Muldoon shaft by a drift and "raises" from the lowest level; and at the top of the latter shaft were installed powerful suction blowers which served to ventilate the mine by drawing fresh air down the main shaft and vitiated air up by way of the Muldoon shaft.

As the fire continued to rage and to spread, the mine experts determined to bulkhead the main shaft of the Argonaut in the hope of smothering the flames by cutting off the normal flow of descending, stimulating oxygen. This was done near the 2,500-foot level. As neither the Muldoon shaft nor the main shaft of the Argonaut could be used for rescue work there remained but one way to reach the imprisoned miners, who were still thought to be alive, and this was by breaking a passage from the adjacent Kennedy mine through abandoned drifts and intervening rock so as to tap the Argonaut mine at the 4,200-foot level. Such was the situation on August 29, when the rescuers, organized by the management of the Argonaut mine, began their task of tunneling from the 3,600-foot level of the Kennedy shaft to the nearest lateral of the Argonaut, a distance of 600 feet.

To prevent confusion, it might be well to explain that the 3,600-foot level of the Kennedy mine actually lies below the 4,200-foot level of the Argonaut mine. This is due to the fact that the Kennedy shaft is a vertical one while the main shaft of the Argonaut dips on a gradient of 65 degrees, and the various levels



*General view of the above-ground activities of the Argonaut gold mine near Jackson, Cal.*



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*At the entrance to the main shaft of the Argonaut mine just after the first rescue party descended.*

are named according to their distance from the shaft mouth. On August 30, the Kennedy people set afoot a second rescue force at the 3,900-foot level of their mine in the hope of breaking into the 4,650-foot level of the Argonaut mine. Ernest Miller, one of the imperiled men, had been caught years previously in a kindred predicament by fire in a mine near Butte, Mont., and by erecting a barrier he had been able for a period of four days to shut out the poisonous gases and to save himself and 25 of his fellows. It was reasonably expected that Miller would urge a similar course in the depths of the Argonaut.

To follow understandingly the line of progress traced by the rescuers working from the 3,600-foot level, it might be well to sum up in advance the task that confronted them in penetrating to the 4,200-foot level of the Argonaut. Briefly, it consisted in working through a clogged drift 125 feet in length, then turning at right angles and drilling and blasting through 60 feet of greenstone, next in traversing a second abandoned and filled drift about 400 feet long, and, finally, in cutting a raise through rock a distance of 77 feet to effect an entrance into the Argonaut mine by way of an open drift.

Francis Henry Hill, an expert operator of pneumatic drills, early volunteered his services to the officials of the Argonaut mine for the purpose of aiding in the release of the 47 entrapped men. His proffered help was accepted and he was asked to assist the foreman of one of the Argonaut Company's rescue shifts. For 21 days straight running he remained with his gang. There were four shifts, each of 30 men, engaged on this level, and the work went on continually day and night. We can probably get a better idea of what took place far below the surface if we let Mr. Hill tell the story in his own words.

"On the 29th of August we went over to the Kennedy mine and down to the 3,600-foot level where we located the old drift which we were to follow for the first part of our battle against time. In tackling that job we had to clear out and to retimber about 125 feet of it before we could start to crosscut through the greenstone. The drift was choked with dirt, timbers, and the piping and the rails which had formerly been part of the operating equipment. Much of this metal was twisted and difficult to dispose of, and we had to cut it into short lengths by hand with hack-saws to get it out of our way. When we got to the point where we had to make the crosscut, matters became a great deal harder.

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*Helmet men going down to fight the fire in the Argonaut mine before the main shaft was sealed to smother the flames.*

"The crosscutting took approximately five days, which is the best evidence of the manner in which the rescuers worked and the speed with which the drilling, blasting, and mucking was done. The second abandoned drift presented a more difficult proposition than the first old drift. It, too, was clogged up, but the dirt was intermixed with caved-in rock, and there was, of course, timbering and tangled metal work to be dealt with. As in the first drift, we opened up a passage three feet high and three feet wide. All of the excavated material was moved to the rear in wheelbarrows a distance of from 600 to 700 feet and disposed of in a neighboring open crosscut, which we used as a dump. Both the shovelers and the men with the barrows had to do their work in a crouching and at times a kneeling position. Indeed they could do nothing else in going and coming through the constricted tunnel.

"To facilitate the conveyance of the dirt to the dump the men worked in relays, each a short distance apart. At the end of every relay a pocket was cut in the side wall just big enough to accommodate a wheelbarrow standing upright. In these the returning empty barrows were put momentarily to get them out of the way of the loaded vehicles which were pushed steadily outward to the dump. There were nine pockets in the drift and the relay service was made up of ten men. All told, it took ten days to pierce the second drift and to get the rescuers to the rock where the raise was to begin. The raise was the last lap of our undertaking, and it meant penetrating an 84-foot wall of rock in order to reach our goal—the 4,200-foot level of the Argonaut mine.

"We were approximately 2½ days in drilling and blasting the raise, and for this work we employed stoper drills. We drilled the top round from a cross-bar, which allowed the muckers to do their work at the same time. Then we dropped down, rigged the cross-bar at the bottom of the drift, and drilled the 'lifters' by which the broken rock was raised and thrown back. Each relieving shift did the mucking for the shot of the preceding shift. Along towards the last, the heat became extremely exhausting. The men worked for only 20-minute periods, and then they crawled back to the station underground for a rest of 40 minutes. I opened up the compressed air line at different points in order to give the men fresher air to breathe; and, undoubtedly, the atmosphere would have been unbearable but for the exhaust from the drills and the air which we released from the line periodically. Occasionally, some of the rescuers, in their desire to hasten progress, would advance to the heading after a shot had been fired before the gases from the blast had cleared sufficiently, with the result that they toppled over and had to be carried out to the rest station where they could be resuscitated.

"Probably I can make it plainer what the physical stress was when I say that I, a slight man, lost ten pounds in the course of 21 days. Some of the other fellows lost as much as 25 pounds. Most of us worked only in undershirts, overalls, and shoes, while others reduced their garb by discarding their undershirts. At the end of a shift our overalls would be soaked

through with sweat and clinging to our legs as though we had been wading in water, and our shoes would slosh with the accumulated perspiration from our streaming bodies. It was no uncommon sight to see the men take off their shoes at the rest station and empty them. No one gave any heed to the drain on his vitality. The Bureau of Mines people gave assistance to the men coming off shift; and I want to acknowledge the splendid work done by the Red Cross women. They were always ready with coffee, sandwiches, and other refreshments whenever the rescuers had a respite.

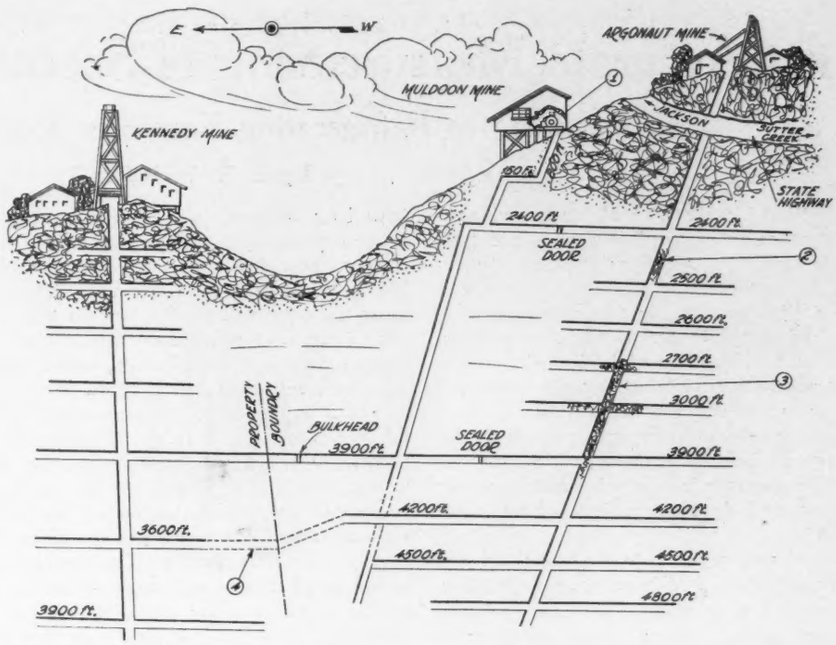
"All the time we were advancing from the starting point at the first old drift we used compressed air from a line which we extended as we pushed onward, and this piping connected with the regular compressed air system of the Kennedy mine. The air was supplied by compressors far above at the surface. Realizing that the success of the undertaking and perhaps the lives of the rescuers depended in a measure upon an unfailing flow of compressed air, it was decided to take steps to guard against a breakdown of the Kennedy compressors. Therefore, a line of 3-inch pipe, 2,300 feet long, was run above ground from three big compressors at the Argonaut mine to the collar of the Kennedy mine shaft where it could be connected up at short notice. The work of joining and laying this line was accomplished in the short time of 7½ hours. As it happened, however, this emergency installation was not called into service.

"I should like to say here that while the Argonaut rescuing force was, in a sense, racing with the Kennedy men who were toiling for the same purpose at the 3,900-foot level of the Kennedy mine, the bonus of $5,000 offered by the mine officials to the crew which should first break into the Argonaut mine had nothing whatever to do in spurring any of the men to their best. The one aim was to reach the imprisoned miners at the earliest possible moment. The rescuers knew full well that they were risking their own lives, and no amount of money would have served to urge them on to greater effort.

"At five o'clock in the morning of September 18, one of the shifts of the Argonaut crew broke through the last of the rock wall and opened a passage into the neighboring, open drift of the Argonaut mine at the 4,200-foot level!

"When we put the hole through, such a tremendous current of air rushed into the Kennedy shaft and up the raise that it was impossible for us to keep lit the flame of a carbide lamp unless the draft door on the main level of the working was held below the raise to check the movement. This current was so strong the next day, while we were removing the bodies through the drift, that we had to use flashlights for illumination. Don't let me get ahead of my story.

"Of course, it should be understood that the Kennedy men at the 3,900-foot level ceased operations when we got into the Argonaut mine. When we broke into the 4,200-foot level we had about 600 feet of open drift to travel before we could reach the main shaft of the Argonaut. Then the helmet men, under the guidance of two rescue experts of the United States Bureau of Mines went forward to explore and to locate the 47 miners. It was necessary to do this before we could take any steps preparatory to getting them out. The helmet men found the victims on the 4,350-foot level.




*1—Blower house. 2—Where timber was removed in Argonaut shaft to check the fire. 3—Area where fire raged. 4—The 3,600-foot level of the Kennedy mine and the route followed by the rescuers in breaking into the Argonaut mine at the 4,200-foot level.*

"The stricken miners had been working before the fire trapped them at various points ranging from the 4,350-foot level down to the 4,800-foot level; and when they realized their peril they gathered at the 4,350-foot level and built for their protection a bulkhead across the drift. This bulkhead was a decidedly clever piece of work. In its construction the miners used timbers taken from the level, and these they stood on end in the drift with the front face of the barrier slanting toward the probable line of approach of smoke and gases. The timbers were set snugly together, and then the men chinked every crack tight with the underclothes which they stripped from their bodies. Finally, from the inner side, the miners threw a covering of dirt upon the bulkhead as a further defense against the admission of any poisonous atmosphere.

"Apparently thinking that the first bulkhead might not suffice, they started to erect a second one about 30 feet farther in. This was never completed, and the work was probably halted when the men collapsed while at the task. There is nothing to indicate how long the unfortunates survived, the only record left by them being a message written with the smoke of a carbide lamp upon the face of the rock. This read: '3 o'clock. Gas getting strong, Fessel.' The supplemental records '3.20' and '4 o'cl.' are supposed to have been made by others after Fessel wandered deeper into the mine seeking an avenue of escape. Fessel's body was not identified among those found behind the bulkhead nor was it discovered elsewhere when a pretty thorough search was made later. When the helmet men came upon the dead miners the latter were generally in sitting positions, which seemed to indicate that they had passed away painlessly."

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*The message on the rock, written with the smoke of a carbide lamp, which foretold the doom of the imprisoned miners.*

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Automobiles are now being used to transport passengers across Mongolia between Kalgan and Urga, a distance of 700 miles; but this mode of transportation is not yet able to compete with camel caravans in the general carriage of freight. However, in order to save time, Russian silver coin as well as furs are sent over this route by motor in five days as against 30 to 40 days by caravan; and another factor in favor of automobiles for this service is that they are seldom held up by the brigands that infest the desert.

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Dalmatia is ready to ship 500 tons of insect-powder flowers. Fancy, turning the flower against the bug!

# First Accurate Measurements of Specific Heat of Ammonia—

## Interesting to Refrigerating Engineers and Ice Manufacturers

By S. R. WINTERS

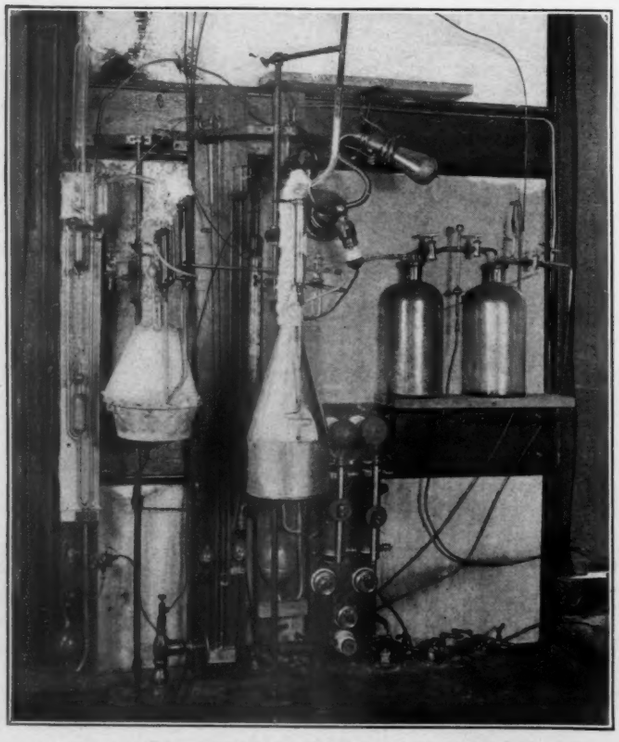
PROBABLY the most elaborate and complicated experimental equipment yet built at the United States Bureau of Standards—requiring the services of three scientists for a period of approximately two years—was recently completed. Construction of the apparatus, itself, with its hundreds of details and innumerable ramifications, involved pioneer work and painstaking effort that were necessarily time consuming. Once the apparatus was built the purpose of its creation, namely, the measurement of the specific heat of ammonia vapor, was successfully accomplished within eight weeks.

The apparatus, which to the uninitiated observer appears to be a bewildering aggregation of smoothly working mechanisms, nice plumbing, and intricate electric wiring, is an enduring testimony to the infinite patience and untiring labors of N. S. Osborne, H. F. Stimson, T. S. Sligh, Jr., and C. S. Cragoe. The finished product is without a duplicate in the United States, and possibly in the world; and in the trail-blazing feat of building the equipment the scientists encountered stumbling blocks that necessitated modifying original plans when these did not coincide with their hoped-for objective. The magnitude of the undertaking may be better appreciated by quoting the following statement of N. S. Osborne, one of the experimenters: "Although the usual precepts have been followed in the work preparatory to the measurements, the element of chance has been recognized as the final salvation from blunders and inanimate perversity, and the successful outcome reflects a kind Providence."

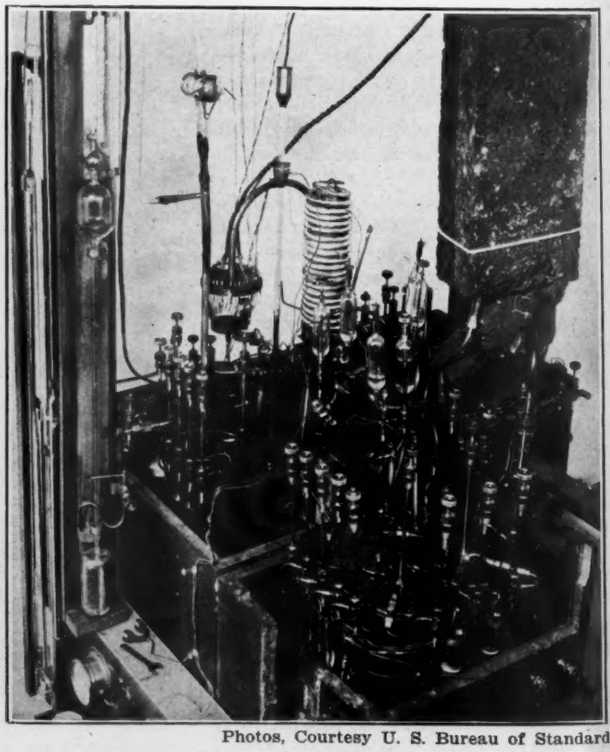
This particular work in the field of research is the crowning result of a series of separate but correlated investigations made at the Bureau of Standards of the properties of ammonia, the values of which refrigerating engineers must know in order to intelligently design and to operate machinery using ammonia for the purpose of artificial cooling or of ice manufacture. About ten years ago, the American Society of Refrigerating Engineers made known to the Bureau of Standards the urgent need of an authoritative table of these ammonia properties—a table to be adopted as a standard in place of the several similar ones then in use, the object being to avoid the disputes arising on account of the discordant data then available.

The completion of this laboratory equipment, and the investigations conducted therewith, will afford refrigerating engineers a table that indicates the refrigerating properties of ammonia and which is at once accurate, consistent, and authoritative. From the standpoint of precision, the ammonia table thus made possible will even surpass the tables relating to the properties of steam. Heretofore, determinations of the specific heat of ammonia were not only inadequate but inconsistent. In order to get anything like satisfactory results, the interpretation of existing measurements called for the exercise of good judgment. The degree of accuracy hoped for at the outset of the investigations at the Bureau of Standards was one-tenth of one per cent.—a negligible quantity, to be sure. The final series of 90 experiments, in which the specific heat of ammonia was fixed at 35 points in the superheat region, was completed in a period of two months.

Like the proverbial needle in the haystack, the actual instrument employed in making the determinations weighed barely one pound, whereas the multitude of accessories weighed approximately 500 pounds. The calorimeter—the instrument used for making the measurements—was designed for the specific purpose of carrying out this notable series of investigations. The calorimeter, together with the elaborate equipment which surrounded it, served to isolate the physical process from external disturbing influences. Of course, in the absence of this complex arrangement, the success of the investigation would not have been assured. Electrical measuring instruments, a balance, vacuum pumps, refrigerating lines, pressure and vacuum gages, electric leads from the calorimeter, ammonia flow lines, and three baths with thermostatic controls, are among

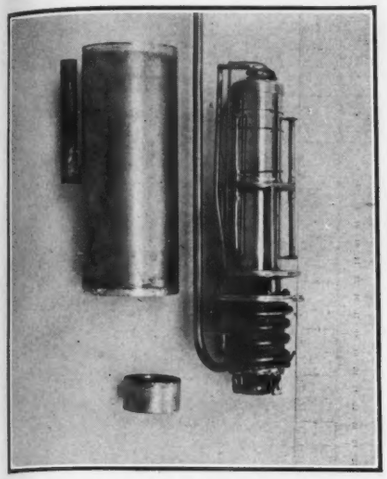


*Some of the accessory apparatus used in controlling the flow of the test fluid in the calorimeter.*



Photos, Courtesy U. S. Bureau of Standards.

*The maze of apparatus surrounding the calorimeter essential in making measurements of the specific heat of ammonia.*



*The partly assembled calorimeter. The calorimeter, itself, weighs barely one pound while the associate apparatus weigh 500 pounds.*

the countless visible units that are contributive to the real instrument for measuring the specific heat of ammonia. Any attempt at a popular description of the apparatus in its entirety would only be a failure—in short, something akin to a Chinese puzzle.

The installation was made in the Low-Temperature Laboratory of the Bureau of Standards, where compressed carbon dioxide was readily available as a means of refrigeration. The apparatus, once set in operation and with an observer to make adjustments, may be considered well-nigh automatic in its functioning, although the actual measurements required three observers and one recorder. The specially designed calorimeter, while intended primarily for studying the behavior of ammonia, may be applied in determining the heat capacities of gases at pressures up to 100 atmospheres and at temperatures ranging from minus 40° to plus 150° C. The inherent difficulty in making a measurement of this kind is the smallness of the quantity of heat in comparison with the volume of the vapor. This circumstance, logically, favored the selection of the flow method as most suitable for the purpose.

The flow method permits the exchange of heat with a considerable volume of gas in a specified period of time and in a relatively small apparatus. The heat capacity of the gas does not figure as a direct element in the measurement. It does, however, influence the speed of arrival at a state of constance of the quantity of fluid to be observed. Essentially, the flow method involves observation of the rise in temperature, produced electrically, of a steady stream of gas traversing the calorimeter at a measured rate. "Sturdy, responsive, and dependable," are the three adjectives that have been employed in describing the calorimeter designed for the particular service of determining the specific heat of ammonia.

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A method of waterproofing cloth by means of the direct application of fresh sap from the rubber tree is practised in the Department of Beni, Bolivia. The latex, which must be less than 24 hours old, is put on with a brush, and the material so surfaced is then passed over the smoke of an ordinary wood fire.

## COMPRESSED AIR USED TO COAT TRACTORS FOR SHIPMENT

A NOVEL use of a compressed air paint sprayer was recently noticed in a Western tractor plant. Tractors and tractor parts that are exported by this company are boxed. It used to be the custom, before boxing, to dip the parts or to paint by hand the more important sections of a tractor so that they would be covered with a protective coat of slushing oil.

Recently this practice was much improved upon. The paint container of a compressed air sprayer outfit was filled with slushing oil. In order to keep the oil thin enough to spray, the holder was set in a sheet-iron tub filled with hot water. The water was kept hot by bubbling through it steam from a nearby steam pipe. One man then went down the line of tractors, ready for export, and with his paint spray neatly put a protective covering on a whole row of machines in the time it formerly took to cover one.

One foreign agent of this company, upon receiving his shipment of tractors, again called a compressed air sprayer outfit into play, but this time to remove the thick, sticky coating of slushing oil. He does this by filling the paint container with kerosene. The compressed air then carries this cleaning agent into every corner of the tractor, quickly and effectively removing the oil.

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## MAKING THE CHOLLA EDIBLE BY FLAME

ROBBING CHOLLA, prickly pear, and other species of cactus of their spines has been a means of converting rank growth into palatable feed for live stock, and has thus saved the lives of thousands of cattle in the drought-stricken areas of Arizona, New Mexico, and Texas during the spring of 1920 and the winter of 1921. The tenacious burs, thorns, etc., of these desert plants are removed as a precaution against the possible ill effects to animals from eating the spines. Once this vegetation is deprived of its objectionable feature, cattle relish the growth and thrive on it in the absence of other feed when Nature gives a scanty supply of rain to nourish less hardy plant life.

An inventive mind has capitalized the opportunity, and has devised an implement for the speedy removal of spines from the cholla and the prickly pear. The illustration shows a Mexican cowpuncher employing a so-called cactus burner after an official of the Forest Service, of the United States Department of Agriculture, had demonstrated its method of operation and its effective use. The scene is on the Santa Rita range reserve in southern Arizona, where the Forest Service maintains an experiment station devoted to the study of grazing on semi-desert areas where cattle still continue to roam about more or less freely. The burning of the thorny growth was first successfully tried by government officials on 50 acres in southern Arizona during the spring of 1921.

Weighing barely a dozen pounds, the burner, shown in the photograph, is easily operated by one man. Shoulder straps, connected to the outfit, facilitate carrying the apparatus about, and the operative's hands are, therefore, left free to manipulate the flame-throwing torch. The tanks containing the distillate—probably a mixture of kerosene and gasoline—vary in size, but the one described has a capacity of 2½ gallons of the liquid. A pipe extends from the tank to the burner, and the distillate is forced through the pipe by air pressure exerted by a hand pump attached to the oil tank. By applying a prescribed air pressure, a hot flame is hurled for a distance of from three to four feet. Cholla spines are extremely dry, and grow in dense clusters, thus lending themselves readily to consumption by the fiery flames. The prickly pear, on the contrary, is more tenacious in this respect and its thorns do not burn off instantly. A Mexican cowpuncher is capable of covering from ten to 25 acres a day with the burner, his industry and the density of the cactus growth, however, being factors determining his progress.

*Burning off spines from cholla cactus to make the plant fit for cattle feed.*

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## WIRELESS WAVES TO COMMUNICATE UNDERGROUND

RECENT TESTS, conducted by the United States Bureau of Mines at their experimental coal mine, Bruceton, Pa., would seem to indicate that wireless waves may be used in the future to effect communication between rescuers on the surface and miners entombed underground by reason of a fire or an explosion.

While the preliminary experiments, made in coöperation with the Westinghouse Electric & Manufacturing Company, failed to develop any practical method of using wireless waves for underground communication, nevertheless the signals were heard distinctly through 50 feet of coal strata. Audibility fell off rapidly as this distance was increased. The absorption, or loss of intensity with distance, is very great for the short wave lengths used in the tests. Longer wave lengths are known to suffer less absorption and may, therefore, be found effective under certain conditions.

To be sure, the mine telephone has been perfected to such an extent that it is giving satisfaction in most mines. However, the telephone system is not infrequently put out of commission, when it is most urgently needed, by the agency that is responsible for a disaster. On this account the mining industry is interested in any means of communication that can be counted upon in an emergency.

# Large Dredged Caissons Finally Seated by Compressed Air

## This Combination of Methods Effected a Notable Saving in Time and Money

By FRANK W. SKINNER

**AS A RULE it is necessary to carry important bridge piers down to rock or to equivalent hard strata. When foundations are sunk to a considerable depth through water the procedure is often troublesome and generally costly. Cofferdams are seldom suitable for undertakings of this character.**

**To facilitate inspection of the foundations and to aid in the reliable construction of vital footings, pneumatic caissons are commonly employed. These make it possible to ascertain the actual physical conditions and render it easier to place materials and to execute essential work. But, on the other hand, they impose limits upon the depth of operations and upon the speed of sinking.**

**The accompanying article discloses how, in building a new bridge in Philadelphia, the contractors have been able to modify the restrictions mentioned and have gained all of the well-known advantages and safeguards incident to the use of compressed air by means of a combination of the open and the pneumatic caisson processes.**

FOR MORE than half a century, the Schuylkill River, at South Street, Philadelphia, has been spanned by an important highway bridge. Although it has been somewhat strengthened in the interval, the structure failed to measure up to present-day traffic requirements and, therefore, the old bridge, during the current year, has been replaced by a new one on the same alignment. This bridge is capable of carrying a larger or heavier volume of traffic and insures a greater clearance for navigation and for river flow.

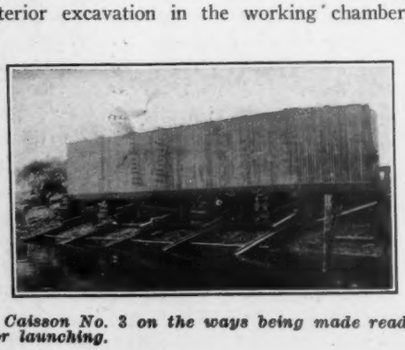
The channel span has been increased from 75 feet to 100 feet, and the head room between the water and the bridge is now 36 feet above high tide. Formerly it was 38 feet above low tide. A superstructure, 46 feet wide between railings, carries two trolley tracks, two highway traffic roads, and two sidewalks. The superstructure is of plate girder construction with a 2-leaf bascule span, 130 feet three inches long between the centers of the piers. There are two fixed spans 118 feet 1½ inches in length, and two others, each 97 feet 4½ inches long, supplemented by a curved approach viaduct and concrete arches at the south end.

Piers Nos. 1, 2, and 3 were built with caisson foundations, while pier No. 4 was constructed on land in a dry excavation. The new substructure clears the former sub-structure, and the methods and the schedules of operations were planned to maintain city traffic on the old bridge as long as possible. The contract for removing the original structure and for building the new one was awarded to the Dravo Contracting Co., Pittsburgh, Pa., for $650,000.

The removal of the old superstructure and the erection of the new one were done under sub-contract by the American Bridge Co. In dismantling, the bridge members were cut into convenient lengths with a number of oxy-acetylene torches and removed without separating the original joints wherever the latter had become fixed. While this work was in progress, the end spans were supported on temporary falsework, but the pivot span was swung into open position so that both ends became cantilevers and were taken down piecemeal, from end to center, without impairing the stability of the structure.

The cribwork and riprap enclosing the old piers were removed by derrick boats. Dynamite cartridges, inserted in hose pipe, were placed by divers so as to encircle the cylinders at the bottom of the dredged excavation and, when fired, cut off the cylinders—enabling the upper portions to be raised by floating equipment while the lower ends remained permanently embedded in the river bottom.

As it was believed that the new foundations would have to be sunk to a depth of 50 feet or more through tough mud, hard clay, cemented gravel, and soft rock, it was considered necessary to employ compressed air for the preparation of the footings in the hard rock, and the contractors elected to build the piers with special caisson foundations designed to promote the greatest rapidity and economy of construction. They therefore advantageously modified and employed a combination of standard methods which are frequently used separately but seldom together. The piers were built *in situ* on timber caissons sunk into position by interior excavation in the working chambers from which the water was not excluded until the caissons had been sunk to hard strata by rapid mechanical operations. After that the working chambers were closed and put under air pressure, making them accessible for the completion of the work and the placing of the concrete by hand.



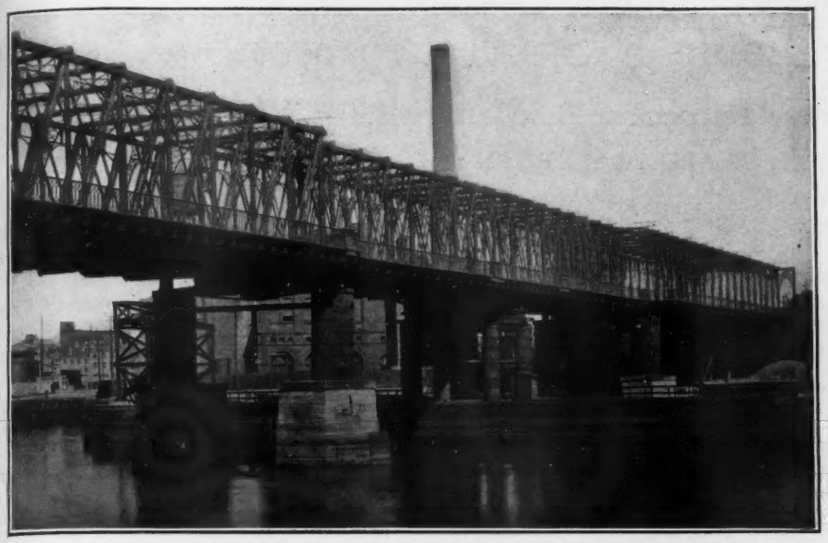
*Caisson No. 3 on the ways being made ready for launching.*

Under favorable conditions a caisson may be sunk to a great depth by dredging in an open well and by loading it either with the pier or some temporary ballast until the friction offers too much resistance to be overcome by the superposed weight. This method is independent of the hydrostatic head which limits pneumatic caisson work; and in some instances requires less expensive caissons, and permits speedier progress and cheaper excavating than the pneumatic caisson procedure. Pneumatic caissons are employed where it is impossible to excavate to the bottom by dredging or by other mechanical means; and are generally used throughout the entire work of excavating and sinking foundations. On previous noteworthy jobs, the contractors successfully combined the two methods by the use of special caissons that enabled them not only to secure the advantages of both types but to reduce the total operating costs.

The duplicate caissons for the piers of the South Street Bridge are 26½ feet wide, 109 feet long, and 40 feet high; they have timber walls eighteen feet high and twelve inches thick surmounted by a detachable wooden cofferdam twelve feet high. The walls taper on the inside to a cutting edge seven feet above which there was placed a steel plate roof pierced by five vertical cylindrical steel shafts seven feet in diameter.

The caissons, which were much lighter than kindred caissons for pneumatic work, were built up to a height of eighteen feet on shipways on shore; they were completed after launching while afloat; towed into position; and sunk in place by depositing in them and on the steel plate roof concrete mixed and delivered by an adjacent floating plant. The caissons were undermined by excavating the material inside of them with orange-peel and clamshell buckets which operated through the vertical cylinders and discharged into scows brought alongside. The mud flowed in under the cutting edges sufficiently to permit the caissons to descend until they reached hard clay and hard-pan at a depth of twelve or eighteen feet in two or three days.

Conical reducers and 3-foot air-locks were then placed on the top of each shaft; the water in the working chamber was expelled by forcing in compressed air; and the excavating continued by gangs of sand-hogs working in 8-hour shifts. Caisson No. 2, which was 26½ feet wide, 109 feet long, and 40 feet high, was dredged to hard stratum in three days, and with this work done air pressure was applied and the



*The old South Street Bridge over the Schuylkill which is being replaced by a larger span to accommodate heavier traffic.*

excavating continued by hand through seven feet of clay, and one foot of hard-pan. The foregoing work, including the blasting of 150 yards of rock and the concreting of the pressure chamber, was accomplished in seven days.

Caisson No. 1, supporting the spans at north end of the bridge, was 15½ feet wide, 71 feet long, and 50 feet high. In the course of two days it was sunk twelve feet by dredging, and inside of eleven days it was put through five feet of hard-pan, two feet of hard mud, and three feet of soft rock by gangs composed of twelve sand-hogs working under a maximum pneumatic pressure of eighteen pounds.

The caissons were filled with concrete to a height of about 30 feet above the steel roof of the working chamber and, after the latter was concreted and sealed, the air-locks and the upper sections of the shafts were removed. The lower sections of the shafts were made solid with concrete, in which they were permanently embedded, and the upper parts of the piers were concreted in the dry in ordinary forms.

The quality of the foundation rock was tested and the piers were anchored to it by drilling holes eight feet deep and placing in them vertical steel dowels, twelve feet long, which projected into the pier concrete. Three-inch cores were taken from the two holes in each of the small piers and from the six holes in each of the large piers, thus securing reliable specimens of the rock which will carry the bridge load.

The dredged material, aggregate, and coal were handled by three orange-peel and two clamshell buckets operated by Dravo whirler derricks with 76-foot booms of 12-ton capacity, equipped with 3-drum Lambert hoisting engines drawing steam from three Dravo vertical boilers having a combined capacity of 200 H. P. Compressed air was furnished by two Ingersoll-Rand straight-line compressors, one a 22¼x24-inch and one a 16¼x18-inch, with an aggregate capacity of 2,000 cubic feet per minute. About 12,000 yards of material were excavated by dredging and 2,000 yards were excavated in the pneumatic caissons. The force employed numbered 165 men, including 75 sand-hogs. The work was commenced in February of the present year, and is scheduled to be completed within twelve months from the start.

The caissons were considerably lighter and less expensive than would have been the case had they been sunk entirely by the pneumatic process. Something like 85 per cent. of the excavating was done by dredging at a cost per cubic yard of about one-sixth of that for pneumatic caisson work. The latter procedure was necessary during the final stages of the undertaking, but a substantial economy was effected by limiting this class of work and employing dredging as far as practicable. In short, sound engineering judgment and a careful analysis of the task involved showed just how the two methods could be utilized to advantage in speeding up operations and in saving money.

## PHYSIOLOGICAL EFFECTS OF AIR MOVEMENT IN MINES

DR. R. R. SAYERS, chief surgeon, and D. Harrington, supervising mining engineer, of the Bureau of Mines, have noted particularly the effect of air movement in mines, and have found that, if the air temperature is above 75° F. and the relative humidity is high, the efficiency and comfort of a worker are increased materially by air movement. With a linear movement of 100 feet, a miner is comfortable and fairly efficient as long as the temperature is not above 85° F., wet bulb. The same is true when the temperature is between 85° and 90°, provided the air velocity is 200 to 300 linear feet per minute. With a temperature of 90° to 95° the air is very oppressive when still, but it is not especially so when it has a movement of 400 to 800 linear feet per minute.

Good ventilation has often been known to increase the efficiency of the miner working in such hot places. Many mining companies have installed and are installing ventilating systems to lower the temperature. One large mining company spent about $70,000 in sinking a ventilating shaft and in purchasing ventilating equipment, and reports that this installation pays for itself once every six months in savings and in the increased efficiency of the workmen. In recent studies it has been shown that the efficiency and the comfort of the miner could be materially increased in high temperatures and humidities by the use of a small portable fan to obtain air movement. This method, however, should be used only in emergencies and as a temporary expedient, because the final solution of the problem is the permanent installation of a ventilating system which will replace hot humid air with cooler pure air, and thus prevent the abnormal accumulation of harmful gases.

*Caisson No. 2 sunk in position showing the derricks and air-locks.*

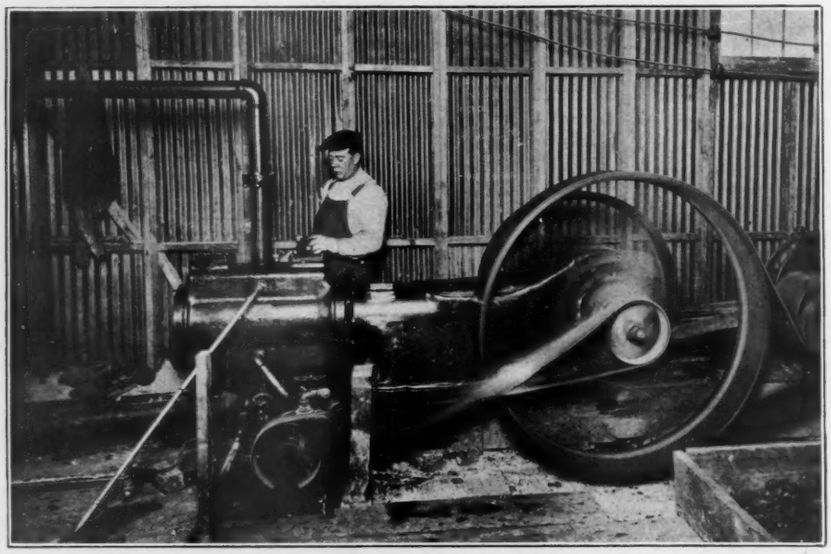
# How to Equip a Small Prospect

## A Question of Prime Importance in Many Mining Ventures

By WARD BLACKBURN

MOST OF THE inquiries for mining machinery which come to the manufacturers of this kind of equipment can be divided into two classes. First, that having to do with a mining prospect located in a new territory where little or no mining work has been done. Second, that class which concerns a prospect situated close to an established property or in a comparatively well developed section.

It is not hard to select a proper outfit for a prospect which falls in the latter group, as the experience gained by the established properties will indicate and govern the kind and the size of the working equipment which should be provided for the new mine. But in the case of a prospect located in unfamiliar territory, the right choice of plant is a difficult matter. The owners and operators of the prospect have no definite information to help them in determining the depth of shaft, the amount of tunneling work, and the length of adit which it will be necessary to drive. There is little data available covering the possible quantity of water to be handled, and none to serve as a guide in the selection of drilling equipment.



*Small belt-driven compressor, requiring a very simple kind of foundation, which has found great favor among prospectors.*

*Drifting with a mounted "Jackhamer." Picture in small square shows a "Leyner" No. 33 sharpener used for the sharpening of "Jackhamer" drill steels.*

The choice of plant for a prospect in a new locality is very often influenced by the amount of money that can be spent; and in many cases too large a proportion of the ready capital is invested in equipment, leaving a comparatively small amount for developmental purposes after the plant is installed. It is generally better to under-equip a new prospect rather than to tie up too large a sum of money in buildings and machinery.

A trip through any mining camp, except where the larger properties have been in operation for some time, will show many over-equipped properties. It has not been an uncommon practice for promotors to install expensive mining plants, including elaborate mills to take care of undeveloped ore, and then to find little or no money left for actual mining operations after the expenditures for plant equipment had been made. Under those conditions it is difficult to interest additional capital, and as a result promising prospects are abandoned.

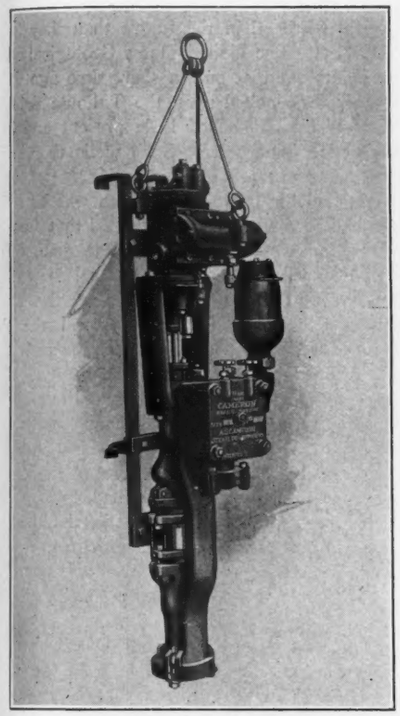
On the other hand, it is an inexcusable waste of money to attempt to open up a prospect without sufficient machinery and equipment to carry on the work in an economical manner. In considering this point, speed of operation is often overlooked. It is a factor which should be given careful thought; and as a rule the work done with machinery carefully selected so as to give the maximum speed will prove the most economical in the end.

To get down to a concrete example, let us assume a case where favorable surface indications have been found and where enough preliminary work has been done to interest mining men so that they are willing to put up $50,000 to determine whether or not they actually have a mine. With this as a basis, and supposing that it has been decided to sink a shaft approximately 400 feet, and to spend the balance of the money in drifting and other developmental activities, then, with economical and well-planned underground work, the shaft could be put down and about 2,000 feet of exploratory work done at a cost around $30,000. Such operations would justify an expenditure of $15,000 for buildings, machinery, and other equipment, and would leave a margin of $5,000 to cover special outlays and to keep the company in a sound financial condition until developmental work is completed, or until it is determined whether or not additional money should be expended, based upon the work already accomplished.

The general surface conditions would give an idea of the amount of water which might be encountered in the shaft. If it is reasonably

certain that but little water will be met with—not more than can be handled by a Cameron prospector's sinker—then the company would be justified in starting off with a 15-H.P. hoist, a 9x8-inch compressor, a 30-H.P. gas engine, and two "Jackhamer" drills. In ordinary ground, one could confidently expect to do the necessary work with this equipment.

As the supposed prospect is located in new territory, housing facilities for a small crew would have to be provided so that the plant layout would be about as follows. The prices given are close estimates and include delivery of the equipment at a railroad station in the southwestern section of this country.



*Differential sinking pump which can be easily raised and lowered in a shaft. This pump has a very simple mechanism and is capable of handling dirty water and of standing much abuse.*

| | |
|---|---|
| HOUSING— | |
| One combination kitchen and dining room fully outfitted. Two small-size bunk houses. One combination office and warehouse building with accommodations for the man in charge of the property | $3,500.00 |
| HEAD FRAME— | |
| One substantial head frame suitable for a 400-foot shaft to cost complete and erected | 500.00 |
| HOIST— | |
| One 15-H. P. Fairbanks-Morse type "Y" oil or gas engine hoist, installed | 2,100.00 |
| COMPRESSOR PLANT— | |
| One 30-H. P. oil or gas engine, class "ER-1," 9x8-inch compressor complete with belt and one 30-inch 6-foot air receiver, including cost of installation | 3,500.00 |
| DRILLING EQUIPMENT— | |
| Three "Jackhamer" drills, complete with hose | 750.00 |
| BLACKSMITH SHOP EQUIPMENT— | |
| One shop including forge, anvil, miscellaneous tools, a No. 33 "Leyner" sharpener with accessories and sufficient steel to make up fifteen complete sets | 1,500.00 |
| MISCELLANEOUS EQUIPMENT— | |
| One hoisting cable, buckets, cars, surface track, picks, shovels, lamps, etc. | 900.00 |
| PUMPING EQUIPMENT— | |
| One Cameron prospector's sinker, complete with suction hose and foot valve | 300.00 |
| TRANSPORTATION EQUIPMENT— | |
| One light truck to meet local conditions | 1,000.00 |
| | $14,050.00 |

Starting out with a capital of $50,000, this leaves a balance of $950 to cover the cost of extra items, such as piping, pipe fittings, special tools and supplies, and to purchase the drill columns and the "Jackhamer" mountings needful for drifting work when the shaft has been sunk.

Give a good all-round small-property operator the excellent outfit we have described, which is a comparatively modest one, then, with a carefully selected crew, the prospecting work could be carried on satisfactorily. If no unforeseen difficulties arose, the undertaking could, undoubtedly, be pushed through without exceeding the estimated total outlay of $50,000.

## A BELT POORLY REPAIRED

NOT LONG ago I was called to take a look at an oil-driven engine which the owner wished to dispose of because it "gave him too much belt trouble." The owner admitted that the engine itself was all right. He could find no fault with it as far as its running ability was concerned but, he said, "It breaks the belt as fast as I can fix it. I spend most of my time fixing the belt."

Of all the belts I have ever laid eyes on I never saw the equal to this one. I maintain that the said belt is the "most patched belt in the world." And I also maintain that it is the "most poorly patched belt in the world." The word "repaired" can hardly be used because it is too dignified a word in this case, and, besides, the belt wasn't repaired. It was just simply "patched." Originally, it was a double leather belt.

Whenever the belt would break the owner would simply take a piece of belting of the same width, lay it over the break, drive some rivets through, clinch the rivets, and let it go at that. No attempt was made to produce a smooth-fitting joint. No tapering down to a feather edge. No gluing. No squaring up with a square. The patch was simply laid on top, and, you might say, "nailed on."

Of course, the joint wouldn't hold long. Another splice would then be riveted on top of the first, the owner doubtless thinking that two splices should be twice as strong as one splice. And when that, again, would break, the owner "simply couldn't understand it." He decided that he would have to sell the engine and install a motor.

The entire belt was made up of splices in this manner, overlapping and underlapping one another until the average thickness was about equal to the thickness of three belts, one on top of the other. Never before has it been brought to my attention so forcibly that whenever a belt needs repairing it pays to do the job right in the first place. In this instance, if the first repair job had been properly done it is quite possible that up to the present time there would have been no need for a second repair job. The joint of a leather belt that is properly scarfed and cemented is just as strong as the solid leather belt itself. Leather-laced joints are of course never as strong as the solid leather, but if the owner had even laced his belt instead of riveting in this unworkmanlike manner he probably would have had much less trouble. Wire-laced joints are stronger than leather-laced joints. They often have a joint efficiency of 85 to 90 per cent. A wire-laced joint could have been used as well as not, and the writer believes it would have held.

## THE USE OF GUNITE IN PRESERVING MINE TIMBERS

ALMOST important question, on which adequate data are not available, is the effect of gunite in retarding the decay of timbers to which gunite is applied. According to government experts, it is obvious that such information can be obtained only by observation of timbers so treated in comparison with others not "gunited" but exposed to similar conditions over a period of years.

Experiments at the United Comstock, North Star, and Empire mines, and at the University of California adit, are being watched carefully, and the final results will be published. From what has been learned of the density and the nonporosity of gunite and its resistance to the absorption of water, it seems reasonable to believe that sound timbers, carefully and completely covered with the plastic coating, will be protected against the attack of fungus and insects, and that decay will thus be retarded or prevented.

## HYDRO-ELECTRIC DEVELOPMENTS IN FRANCE

A RAPIDLY growing interest in the development of hydro-electric power is noticeable in France, and public sentiment is keen for the utilization of water-power to overcome the dependence upon foreign importations of coal. The extent of this urge is evidenced by the fact that in 1913 only 930,000 H.P. were generated by water whereas in 1921 a total of 2,100,000 H.P. was so produced.

Important individual undertakings include the Rhone development; the project for harnessing the Dordogne River, which embraces seven generating plants and the world's largest dam; and those for developing the Ossau and Aspe Rivers. Indications point toward a greater and more general use of electricity for industrial purposes; and it is expected that the ferro-alloy output of France will be largely accomplished within a few years by electric furnaces.

## AN EFFECTIVE DANGER SIGN

OVER a particularly smooth and innocent looking piece of road in Tennessee there swings a 40-foot sign decorated with skull and crossbones and reading: "Drive Slow—Dangerous as the Devil." Less than 400 feet from the sign are two hidden, blind, narrow, turns—not curves—bearing right and left at almost 90°. The sign has been so effective that only one fatal accident has occurred there in ten years, and in that case they said: "That durn fool was full of mule, had a 3 to 1 gear on his flivver, and couldn't read, nohow." The sign idea might be useful in some other places.

# Compressed Air Magazine

—*Founded* 1896—

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*EDITORIALS*

## SANTA CLAUS AND SERVICE

THE ARRIVAL of December, no matter what may be the number of our years, reminds us of the nearness of Christmastide and the things that have been associated with that season ever since our childhood days. All of us can recall how then we talked and dreamed of SANTA CLAUS and what we expected in our stockings if we were good and mindful of our elders. It was a period of thrills, and we were urged to our best behavior, at least for a while, by the thought of the rewards that might be ours.

Then, after a few years, we awakened to the disillusioning fact that the jolly, rotund patron saint of children was only a fiction, and there was a more or less painful period of readjustment and simulated cynicism of the grown-up as we accepted our parents or other loved ones in SANTA CLAUS' stead.

A little later we outgrew the stocking-age of celebration and came to look upon Christmas as a worldwide day of heartsome expectancy and cheerful giving—a pleasing custom. Still later, perhaps, we acknowledged the season as an institution we had to be mindful of lest we be dubbed grumpy curmudgeons, giving then grudgingly and only to save our faces. SANTA CLAUS and Yuletide practices generally were no longer accorded even lukewarm contemplation —an unhappy symptom of the psychology of all too many of us and ample warrant for pondering.

Why not let us recall now that SANTA CLAUS has always stood as an exemplar of cheerful, self-forgetful service bent upon bringing joy to one and to all that would open their hearts to him: the laden stocking representing the material reward, through him, of childhood's efforts in the direction of obedience, good conduct, and improvement in divers ways. Why can't we grown-ups take these associations of early youth into our maturer years and grasp the force for good that lies in their perpetuation?

Why can't we recognize that our best efforts, our wholehearted will to give fullest service can make each of us our own SANTA CLAUS? This would put us in the way of filling a figurative stocking, maybe many of them, with the things that really count—earning that most comforting of returns, the consciousness that we have made the most of our powers and have won the good will of our fellows.

SANTA CLAUS can be as real for us to-day as he was when we were in our infancy and, possibly, a great deal more effective for the commonweal. The cheerful worker in any walk of life, no matter how high or how lowly his plane of occupation, can make all of his labors lighter and transform every day into a Christmas day. He can be a blessing to himself and an inspiration to those around him. Let all of us revitalize a beautiful fiction and turn it into a helpful, heartening daily force for good in the years to come. The world, in everyone of its social and industrial relations, is sorely in need of this spirit now.

## CONGESTION AT BUFFALO AND THE ST. LAWRENCE SEAWAY

NOBODY will claim that we are at present living in an era of excessive prosperity. Some think we are beginning, others that there may be a recession. Be this as it may, even now the farmers of the West are suffering through the lack of facilities for shipping grain to Europe because of a congestion at Buffalo.

Mr. JULIUS BARNES, president of the Chamber of Commerce of the United States, an expert on this subject, has recently given a statement to the Associated Press to the effect that it has been impossible to make engagements for grain shipments from Buffalo to New York on the Erie Railroad since August 30, last; on the West Shore Railway since August 24; on the Lehigh Valley since September 1; and on the Lackawanna since September 2.

The result of this has been to advance the price of grain in the Liverpool market the equivalent of 2½ cents per bushel during the same period that it has fallen 1⅜ cents per bushel in the Chicago market, and 2⅞ cents at Winnipeg.

It is reported that vessels have been lying at Buffalo and Port Colburn unable to unload; and that shippers are paying $800 per day demurrage. It is further reported that the situation has grown worse since the foregoing figures were made. This threatens a loss of the entire profit on grain to our Middle West agricultural producers. Such a state of affairs is a tragedy.

Even though it may be claimed that part of this congestion is due to the recent strikes, the argument for a seaway in competition with the railroads to relieve the situation is emphasized.

## THE REJUVENATION OF OLD OIL FIELDS

FROM TIME TO TIME we have been jarred by official pronouncements to the effect that we were fast exhausting our underground reserves of petroleum. But now come from government experts the glad tidings that dwindling fields and abandoned sands may be stimulated afresh and possibly may be made to yield more oil in the future than they have in the past. The United States Geological Survey points out that only a short time ago most oil operators looked upon the Tidioute field in Pennsylvania as one of little present and less prospective importance. Such wells therein as were being pumped gave insignificant amounts of oil; and the prevailing opinion was that the field had been so thoroughly drilled that further exploration would be futile. One man, however, declined to accept the general view, and clung obstinately to the idea that the early drilling had not conclusively proved the absence of oil in sands lying deep beneath the beds drained by producing wells.

In the face of skepticism and no little ridicule, this prospector awaited his opportunity and drilled a deep well, and early last August, when his drill bit into the Queen sand, 770 feet beneath the sand which had up to then yielded most of the oil in the district, he obtained a flow of petroleum which served to silence his critics and to restore to importance one of Pennsylvania's oldest producing fields. The well gave 500 barrels a day.

While this rejuvenated well was a subject of wonderment, another old field in the state "came back" with an even larger producer. This well, in the Unity field, yielded at the rate of more than 1,400 barrels a day—again proving that drilling in old fields is likely to pay if it be intelligently directed. What has been done in Pennsylvania has been duplicated elsewhere in both the Appalachian and the mid-Continent fields.

## OUR BUSINESS PROSPECTS IN LATIN AMERICA

THE LATIN AMERICAN countries are all of them undergoing economic development at that stage which centers the energies of their peoples upon the production of raw materials rather than manufactured commodities. As might be expected, therefore, the trade of the different regions is marked by specialization in some outstanding product and the people must depend on foreign markets for their prosperity. For instance, we find that Cuba is most active in sugar; Chile relies very largely upon her saltpeter; the River Plate regions are strongest in their traffic in wheat, wool, and hides; Southern Brazil is mostly concerned in the growing of coffee; rubber is the dominating commodity in the Amazon Valley; and thus it goes.

Though the difficulty encountered in obtaining goods from abroad has stimulated domestic manufacture in some of the more advanced and populous sections of South America, the peoples there still find it necessary to import the bulk of the finished commodities desired by them; and this state of affairs is likely to continue for a good many years to come. Herein lies one of the most cogent reasons for the cultivation of close business relations between the northern and the southern continents of this hemisphere.

Latin American trade with the United States is more extensive now than is generally realized, and for the first eight months of the present year it was bigger in value by 8 per cent. than during the whole of the fiscal year of 1913-'14. Of great and far-reaching significance is the fact that American investments in private enterprises and in the bonds of the governments of Latin America have amounted to over $500,000,000 since the early part of 1921. While most of these loans have been for the purpose of refunding, their ready sale in the United States indicates a broader knowledge on the part of our citizens of the stability and the responsibility of these nations, and this understanding is certain to be reflected henceforth in better and more profitable business relations.

## BIG DISCOURAGEMENTS

THE RESIGNATION of Dr. SAMUEL WESLEY STRATTON, Director of the United States Bureau of Standards of the Department of Commerce, to become President of the Massachusetts Institute of Technology, is an event of unusual interest and of wide-reaching significance, such as is not at first fully apparent. He is leaving a job which is preëminently his job. He had the directorship of the Bureau from the very start in 1901. During the first year of its existence, the Bureau had the expenditure of an appropriation of $200,000, which was the beginning of a great scientific laboratory that has since been entrusted with the expenditure of more than $2,000,000 in a year's work. It is now said to be the largest physical laboratory in the world and employs more specialists of high status than any other single agency.

We can well understand the pride and satisfaction of Doctor STRATTON in the great success and growth of his work, and the personal devotion to its interests and activities is not easily to be overcome. The impelling, the compelling conditions are not far to seek, and none can say that the action taken is not fully justified. A man has to live, you know, and to look out for his family and the future. It is understood that his change of position increases his salary three-fold, and that alone is a sufficient justification. We might even say that a refusal would be culpable and without excuse.

But that is not all. The salary enticements have been operative also upon his most valued and trusted assistants and subordinates who are successively leaving the Bureau for more remunerative positions elsewhere, so that there can be no assurance of stability and no serene confidence in the orderly continuance of operations upon the high level so laboriously established. Most discouraging and repellent of all has been the low estimate which Congress has held of the importance and success of the work, as evidenced by the niggardly appropriations of recent years. It cannot be expected that the vacant position can be filled by anyone but an essentially cheaper man. *R.*

## THE UNEMPLOYED IN ENGLAND AND IN FRANCE

EVERYONE agrees that to distribute doles to the unemployed is demoralizing and expensive. Yet in a period such as this, following the great war, the English policy has been to take care in this way of the unemployed even though it is costing millions of pounds to do it. This view is one of humanity tinctured by politics. It is like feeding the starving through a government whose existence depends upon the votes of the whole people.

The demoralizing effect of a dole is that when men once get accustomed to being paid for doing nothing they are not likely to want to work. Their capacity to work is dulled: their ambition stupefied, but, even so, the answer is—we cannot let them starve.

Being a great industrial country there is little opportunity in England to put the unemployed into the fields. The industries do not need them, inasmuch as the labor equipment is now quite equal to the business requirements. There are few roads to build, for nowhere does one find public roads in better condition than in England. Ships are not needed. It would be very unwise to take a step backward in industry and abandon the use, for instance, of automatic tools simply for the purpose of keeping men employed. This would result in an economic loss; prices of products would be increased; and the number of them sold correspondingly reduced. In view of these facts there seems to be no alternative in Great Britain but temporarily to feed those who are unable to find work. Fortunately, the condition is getting better, not worse; and there has been a reduction of about 12 per cent. in the doles so far this year.

Unemployment sometimes has, in itself, the elements of its own cure. The fact that men are out of work naturally brings about a lower price for labor, which, if properly employed, should result in a greater production per unit of labor, which is the sure road towards prosperity.

In France, the condition is quite different. France is largely an agricultural country. Perhaps half of her people are engaged in agrarian pursuits. A large portion of the territory has been destroyed by the war. In consequence, there is little or no unemployment in France; yet the government is spending millions of dollars per year on roads and buildings. The unemployed in France are working for the government, except where they are required on the farms or in the industries. It has been noticed of late that in driving through a French village of perhaps 500 to 1,000 inhabitants at, say, nine o'clock in the morning, there is no one on the streets and scarcely any one, other than very old people or little children, on the door steps. Country towns in France look like deserted villages, even though all the buildings are occupied. The people are at work—men, women, and children. They begin at sunrise and work till sunset except in the shops, where shorter hours are observed.

October 10th, 1922.

The Editor,
Compressed Air Magazine,
11 Broadway, N. Y. C.

Dear Sir:—

On page 289 of the October number of COMPRESSED AIR MAGAZINE, under the title, *The Air Lift and Air Lifts*, inference is made that the origin of the name air lift is not generally known, whereas the writer believes that it is pretty generally recognized that Dr. Julius G. Pohlé, the man who first made the air lift a commercial success, christened this method of pumping quite properly when he called it the Pohlé air lift pump. The name "Pohlé" was gradually dropped as his patents were set aside and inventors came into the field, but the fact that Doctor Pohlé chose to call his pump an air lift as early as 1892 gives us good authority for the name, and is undoubtedly the reason why it has survived. Other types of pumps, operating by direct pressure of compressed air, are not, properly speaking, air lifts in any sense of the word. They operate by the direct displacement of compressed air, as you say, and have always been termed ejectors, water elevators, or displacement pumps.

The statement is also made that the name air lift is misleading because it does not correctly describe the actual working of the pump. In this statement the writer would also beg to disagree, for although the action of the pump, as described in your article, is correct as far as it goes, you omit the first important element entering into the operation of a pump of this type, which, after all, is the main spring of the whole cycle, if it can be called that. It is the energy in a volume of compressed air released in a fluid column that causes the pump to operate. Then follows the force which causes the pump to operate continuously, which is supplied by the unbalanced hydrostatic pressure resulting from a mixed column of water and bubbles of air on one side, opposed by a solid column of water on the other.

Therefore it seems to me that the air lift is entitled to its name, and all others are infringers.

Yours respectfully,
H. T. ABRAMS.

The National Exposition of *Power* and *Mechanical Engineering* will open at the Grand Central Palace, New York City, on December 7, and will continue for a week. The purpose of the exposition is to bring home to the general public the tremendous force for good exerted by the engineer in modern civilization. We are living in an age made possible by the utilization of invention and research; but of the millions of people in the world only a few hundred thousand have any definite conception of the multitude of great ideas that have been put to work for the benefit of humanity. The exposition will serve to bring these achievements and their applications to the understanding of the populace.

## A GOOD MAN CLIMBS HIGHER

BERTRAM D. QUARRIE, one of the prominent younger figures in the iron and steel industry, has recently resigned his post with the American Steel & Wire Co., of Cleveland, O., to identify himself, in the capacity of general manager, with the Otis Steel Co., of the same city. Mr. Quarrie had been associated with the American Steel & Wire Co., for more than fifteen years, and for the past twelve years was their general superintendent of blast furnaces and steel work.

Mr. Quarrie began his career in the drafting room in 1903, in which year he was graduated from the Case School of Applied Science, Cleveland, where he studied chemistry. Subsequently he took a position as chemist for the Grasselli Chemical Co., in their Cleveland plant. This post he resigned to specialize in iron and steel; and in order to do so he started as chemist at the iron ore mines of a big company in the Mesabi region. Then he became chief chemist at a blast furnace plant in Milwaukee.

*Bertram D. Quarrie*

In succession, Mr. Quarrie worked as chemist for the Cleveland Furnace Co., which concern soon appointed him blast furnace superintendent; as assistant superintendent of blast furnaces at the Central furnaces of the American Steel & Wire Co.; and as blast furnace superintendent of the Inland Steel Co., Indiana Harbor, Ind. There he remained but six months to go back to the Central furnaces as superintendent. This was in 1907. Two years later he was active on the blast furnace committee of the United States Steel Corporation; and in 1910 Mr. Quarrie succeeded Mr. Henry A. Barren as superintendent of the Newburg Steel Works of the American Steel & Wire Co.

Concise as this sketch of Mr. Quarrie's business career necessarily is, yet it brings out a record of advancement of which any man may be proud.

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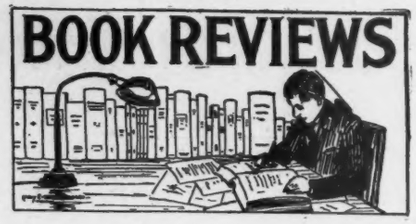
The Department of Labor and Industry of Pennsylvania has recently adopted a code for guidance in tunneling and in other work calling for the use of compressed air. This code is modeled substantially on that sanctioned by the States of New York and New Jersey.




A TREATISE ON MILLING AND MILLING MACHINES, issued by the Cincinnati Milling Machine Co., Cincinnati, Ohio, is a book of 441 pages, extensively illustrated. Price $1.50.

ANY ONE interested in this broad subject, which so intimately concerns industrial life in many of its departments, should add this volume to his shelf of technical books. As is well known, there has been an extremely rapid development in the art of milling during the last few years, and the company concerned has carried out some very exhaustive experiments in cutter design, in cutter and work cooling, and in other phases of this whole question of milling. As a result, marked improvements have been made. All of these topics are ably and fully dealt with in the 21 chapters.

Some of the chapters cover the computations involved in cutting spur, bevel, spiral, and worm gears; and care has been taken to present these topics in a simple, detailed manner calculated to make the information clear and useful to those to whom the usual method of treatment is generally too much involved for ready understanding.

---

THE SAMPLING AND ANALYSIS OF PIG IRON, a pamphlet of 40 pages, price $1. Published by the Carnegie Steel Co., Bureau of Technical Instruction, Pittsburgh, Pa.

THIS BROCHURE supersedes one of a similar character which was issued in 1912, and is the latest of a series of six which have appeared at intervals since 1914. While primarily prepared for the use of the chemists of the constituent companies of the United States Steel Corporation, the pamphlets should nevertheless be of value to chemists generally in our industrial fields, especially those that have to do with the metallurgy of iron and steel.

For the sake of those who may not be familiar with the subject matter of the other pamphlets the following list is given:

The Sampling and Analysis of Gases, 60 pp. $1.00
The Sampling and Analysis of Iron Ores, 62 pp. $1.00.
The Sampling and Analysis of Alloy Steels, 81 pp. $1.00.
The Sampling and Analysis of Ferro-Alloys and Bearing Metals, 71 pp. $1.00.
The Sampling and Analysis of Fluxes, Cinders and Refractories, 64 pp. $1.00.

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TWENTIETH CENTURY GUIDE TO CORRECT PRONUNCIATION, by H. D. Vincent, A. M., and T. E. Lockhart, A. M. A book of 63 pages. Price 60 cents. Published by Atkinson, Mentzer & Co., New York

AS POPE has said, "In words, as in fashions, the same rule will hold, alike fantastic if too new or old." Just as we are judged by the style of our dress so we are evaluated by our speech. Nowadays, a man might as well wear baggy trousers and a wrinkled coat as to pronounce his words incorrectly among others whom he may wish to impress.

The authors of the Guide have made a careful selection of over 1,000 words in common usage which are frequently mispronounced. The aim of the little volume is to satisfy a recognized need. Compared with the great number of words in our language, the American people pronounce most words correctly. Since the language contains over 200,000 words, it is very likely that not more than one-half of 1 per cent. of the total number is incorrectly pronounced. But compared with the number in actual use, the measure of this kind of error is very much higher. The purpose of the book is to help us to avoid even these conversational shortcomings.

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AN INTRODUCTION TO THE STUDY OF LABOR PROBLEMS, by Gordon S. Watkins, Ph. D., Associate Professor of Economics, University of Illinois, 664 pages, $3. Published by Thomas Y. Crowell Co., New York.

ANY THOUGHTFUL contribution towards a solution of labor problems should be welcomed by everyone that is interested in the lasting adjustment of the so-called struggle between the capitalist and the wage earner. Professor Watkins has sought in the writing of his book to fill the great need for a comprehensive treatment of labor problems in modern industry and for the presentation of the proposals that have been advanced for the solution of these problems.

It is recognized that during the last decade great changes have occurred in the principles and the policies of labor management, the aims and methods of organized labor, and the purposes and practices of employers' associations. These changes, together with their historical background and their social and economic significance, are described and analyzed in this volume. In handling his subject, Professor Watkins has weighed his evidence carefully in the light of his wide industrial experience. The book should prove helpful to the student, the labor manager, the labor leader, the employer, and the general reader.

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THE Bureau of Mines of the Department of the Interior has published the following new bulletins and technical papers:

BULLETIN 209. Fusibility of ash from coals of the United States, by W. A. Selvig and A. C. Fieldner. 1922. 119 pp., 2 pls., 3 figs.

TECHNICAL PAPER 276. Safe mechanical equipment for use in shaft sinking, by R. H. Kudlich. 1922. 12 pp., 1 pl., 6 figs.

TECHNICAL PAPER 307. Permissible explosives, mining equipment, and apparatus, approved prior to March 15, 1922, by S. P. Howell, L. C. Ilsley, D. J. Parker, and A. C. Fieldner. 1922. 21 pp., 1 fig.

TECHNICAL PAPER 309. Recent progress in the thawing of frozen gravel in placer mining, by Charles Janin. 1922. 34 pp., 5 pls., 4 figs.

TECHNICAL PAPER 313. Production of explosives in the United States during the calendar year 1921, with notes on mine accidents due to explosives, by W. W. Adams. 1922. 25 pp.

## HOW THE LEGUME CROPS GET NITROGEN FROM THE AIR

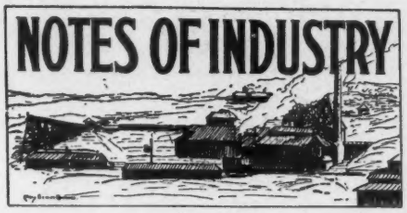
THE LEGUME family of plants includes such common crops as peas, beans, clover, sweet clover, and alfalfa. These crops have the peculiar property of being able to use nitrogen from the atmosphere and to store it up in their bodies and in their seed. By growing such crops, nitrogen may be made ready for the use of other crops not having the power of absorbing the atmospheric nitrogen.

If the roots of a healthy legume plant are examined, there will be found certain little nodules varying in size and shape according to the kind of plant. The nodules are due to the action of certain bacteria which have entered the plant roots and have caused a peculiar kind of growth in the tissues of the plant. These bacteria are in some way capable of taking the nitrogen from the atmosphere and of combining it with other elements so that the legume crops are able to grow in a soil which is absolutely barren of the element nitrogen. When the legumes are ploughed under, the nitrogen, of course, goes with them and is mixed with the soil. When the plants decompose, the nitrogen may be used by non-leguminous crops. According to J. G. Hutton, South Dakota College of Agriculture, careful investigations show that one ton of clover hay contains about 40 pounds of nitrogen taken from the air. A ton of alfalfa hay contains about 50 pounds of atmospheric nitrogen. It may be seen that a ton of clover or alfalfa hay is therefore worth $16 to $20 for the nitrogen alone. It it also evident that it does not cost as much as this to produce a ton of hay.

## HOW MUCH DOES IT COST TO RUN A STEAM SHOVEL?

IN VIEW of the fact that contractors have from time to time accused shovel makers of too much optimism in regard to figures on maintenance costs, the various manufacturers, through the Erie Steam Shovel Co., of Erie, Pa., have decided to settle this question by the aid of a prize contest. The contest is to continue until December 31, and twenty prizes are to be awarded for the best up-keep records made by owners or managers of steam shovels or such employees as are in direct contact with steam-shovel work. Every record submitted must be accompanied by a written statement from the owners of the machine to the effect that the figures are correct; and the record should include approximate number of days the shovel has worked, yardage moved, kind of materials handled, and all up-keep costs exclusive of cable, dipper teeth, and grate bars. It is expected in this way to get together a wealth of valuable information which is to be published for the benefit of the owners and operators of excavating equipment.

The Bolivian Government has advertised for bids for the construction of the Potosi-Sucre Railroad from Betanzos to Sucre, the section from Potosi to Betanzos—a distance of 40 miles having already been built. The remaining section will be 60 miles in length, and the estimated cost of the undertaking is put at $7,000,000.




It will be of interest to the average reader to know that American capital dominates the oil-field interests in Mexico and that $130,000,000 of our money is invested there in the business as against $69,000,000 by the British. The mining companies are also controlled by Americans with an investment of about $250,000,000, whereas English capital to the amount of $50,000,000 is sunk in that industry. Mexican-owned mines are valued at about $50,000,000. The electric light and power plants, on the other hand, are almost entirely in the hands of the British, and the capital invested in those plants by the British, the French, and the Americans, amounts to $125,000,000, $10,000,000, and $6,000,000, respectively.

It is reported that an Austrian has invented "pneumatic, pulsating wings" for airplanes, which are said to be revolutionary in airplane construction. As the news account explains, airplanes with fixed wings and an engine-driven propeller are inferior in relative performance to those embodying wings of the new type.

The extensive ranges of Rio Grande do Sul, Brazil, which furnish grazing to more than 10,000,000 cattle, are now almost entirely fenced in, and this work of confining the herds has created a heavy demand for barbed wire. Most of the wire used for this purpose is imported from the United States.

Montreal, Canada, is the seventh greatest port in the world and the second greatest in America.

According to the latest available figures—those for the year 1921—the United States exported in that period refrigerating and ice-making machinery to the value of $3,391,000.

For the first time since 1920 copper production exceeded 100,000,000 pounds in August, and was almost five times as high as that of a year ago.

Over 60,000,000 feet of instructional films are being distributed free to the people of the United States by the Bureau of Commercial Economics, Washington, D. C. The reels that are being circulated are for the purpose of teaching the citizenry how manufactured articles of every description are produced; how to grow vegetables and fruits of all kinds; and how to raise livestock. As one man has expressed it: "Moving pictures speak a universal language and the impressions through the eye have been proven to be over four times as powerful and enduring as the impression through the ear by the spoken word."

Most of the paving in Japan was formerly of Japanese pine but some of the streets of Tokyo are now to be paved with Douglas fir blocks which are to be manufactured and creosoted locally. However, more durable roads are planned for this city, and it is estimated that before the end of 1926 the percentage of various kinds of paving will be about as follows: wooden-block paving, 11 per cent.; stone, 5 per cent.; asphalt, 52 per cent.; and asphalt macadam, 32 per cent.

Based upon previous experience in devising a method for weighing air, the United States Bureau of Standards has been able to perfect an arrangement for determining very accurately the flow of bleaching gases used in flour mills.

Rye is to be the medium of exchange in Oldenburg, Germany. Rye notes are to be issued based upon the value of rye and will be worth a certain quantity of rye. After four years, the holder of the notes is to receive the gold value then prevalent for the amount of rye indicated on the certificates.

Statistics tell us that even though there are 1,979,000 automobiles on our farms but 30.7 per cent. of the market has been covered.

The Missouri River is one of the great drainage channels of the United States, measuring all told about 2,400 miles. According to the United States Geological Survey, it drains 527,155 square miles, a territory as great as that embraced by all of the states south of New York and east of the Mississippi, except Indiana and Illinois. The Missouri, which is no longer utilized to any extent for transportation, is destined to play a big part in the development of its drainage basin by furnishing water for irrigation and for the generation of power.

Explosives are among the most important articles of import into Iquique, as well as into all the other northern ports of Chile. Ordinary black powder is manufactured locally, but high explosives still come from abroad. An American firm is about to build a branch factory near Antofagasta for the purpose of supplying the latter material.

The export trade of the United States in chemicals and allied products is growing so rapidly from month to month that the total value for the year will, in all likelihood, exceed that for 1921. Large export shipments of naval stores have been made—the combined exports of tar, pitch, and wood turpentine for the first eight months of 1922 having increased 260 per cent; spirits of turpentine 67 per cent.; and rosin 58 per cent. Great Britain continues to be the United States' best customer for rosin and spirits of turpentine. The exports of explosives were more than double, advancing from 5,692,000 pounds in 1921 to 11,657,000 pounds in 1922.

There are 16,246 miles of railroads in Mexico and 56,000 miles of telegraph wires.

*The Ingersoll-Rand Company's exhibit at the recent convention of the American Electric Railway Association, Municipal Pier, Chicago, Ill., at which working demonstrations were made of pneumatic tie tamping, rail drilling for angle bar bolts and for bonding, backing off and running on nuts of joint bolts, cleaning by use of wire brush and sand blast, paint spraying, cutting out concrete paving with concrete pick—in short, there was shown a complete line of air-operated tools covering substantially every phase of track construction and maintenance work. The air was supplied by one of the company's portable compressors, such as is now very widely employed in this field of service. The demonstrations created a great deal of interest among street railway engineering and maintenance officials, who readily appreciated the economies to be effected by recourse to these labor-saving apparatus, to say nothing of the economy in time in the performance of a job and the superior quality of the work done.*

## INVENTORS IN THE TEXTILE FIELD

THE PRODUCTION of cotton presents at the present time two distinct problems for the practical inventor, both of which he is attacking with encouraging results. First, there is the guarding of the crop from the ravages of the boll weevil, and both chemists and mechanical inventors are at work; and then there is the picking of the cotton which, as we know, must be done rapidly and at the right time. By hand, only 70 to 150 pounds can be picked per day, while a new electro-pneumatic picker gets 400 to 700 pounds in the same time. The electric picker plucks the boll and with a combing movement separates the cotton. Then a blower device cleans the cotton and delivers the fiber in an accompanying receptacle.

The flax growing industry is crying even more loudly for the inventor to help it. In Ireland the flax growing industry has declined most wofully and it is said that only the mechanical flax puller can save it. The flax can be harvested only by pulling and the operation must be done when the conditions favor. We have accounts of the recent trials of three of these machines in Irish fields, the most promising coming from Canada, and invented by a clergyman.

Then there is the marvelous and apparently completely successful invention of artificial silk which is said to excel the silkworm product in every essential particular, and can be produced in unlimited quantity and with varying characteristics, as required.

The industrial and commercial developments which these things suggest call for no comment, but offer food for thought.

## TAKING THE LABORATORY TO THE BRICK KILN

THE BUREAU of Mines, United States Department of Interior, has equipped a traveling laboratory for demonstrating methods of conserving fuel at brick-manufacturing establishments in certain regions of the United States. This touring laboratory, designated as "Holmes," is the only railway car of its kind in the United States, and possibly in the world. Headquarters for this demonstrating equipment are maintained at Columbus, Ohio.

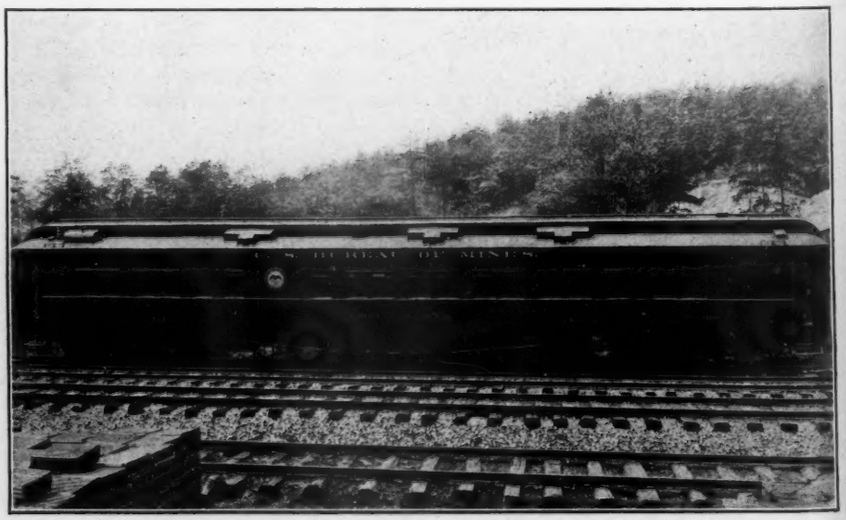
The mission of this laboratory is to visit different brick kilns in the producing centers and to indicate the wasteful practices in the consumption of fuel. This criticism is sustained by the development of practical ways for improving conditions in firing brick plants. A recent visit to a brick kiln in St. Louis, Mo., was fruitful in effecting a saving of fuel as well as in insuring the manufacture of a superior brick product. Similarly, a demonstration at South Park, Ky., made it possible for the superintendent of this laboratory car to suggest changes in construction and in operation of the kiln that resulted in the conservation of fuel and in the production of a better type of brick. It is estimated that the lessons taught by this railway laboratory have effected in some instances a saving of one-third of the fuel supply.

## THE GREATEST RETAILER IN THE WORLD

THE following information is given by Mr. Cornelius M. Sheehan, Deputy Commissioner of the Department of Water Supply, Gas, and Electricity of the City of New York. It should not be forgotten what a hand compressed air has had in providing the supply. It will be noticed that the goods are not only sold but always delivered.

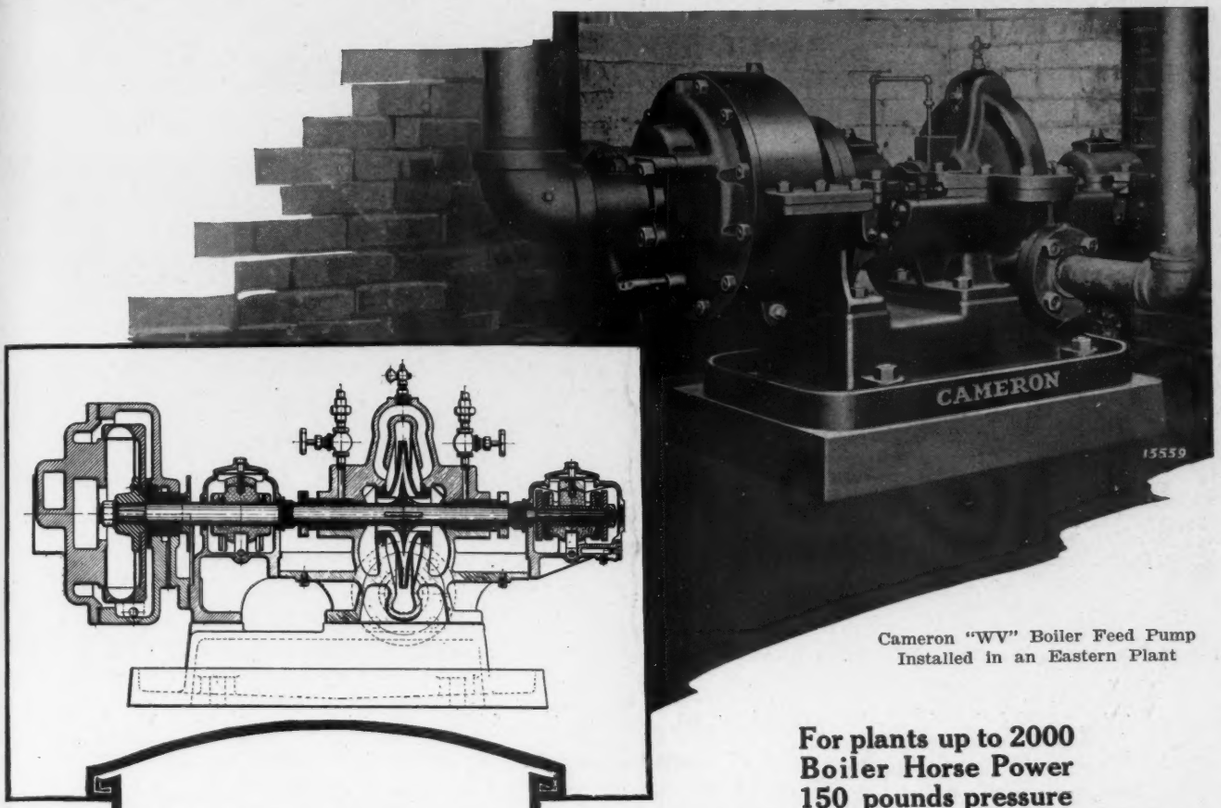
"The Water Department gives service 24 hours a day, 365 days every year. It has 6,000,000 satisfied customers, sells on an average per day 700,000,000 gallons of water or 5,000,000,000 gallons a week—nearly 250,000,000,000 gallons a year. As to price, nothing in the world exceeds it in cheapness. It sells a ton of water for four cents; 75 gallons for one cent, while private water companies sell bottled water at eight cents a gallon or 600 times as much. The average consumption per capita is 131 gallons a day at a cost of 1.9 cents. The average consumption for domestic purposes is 40 gallons per capita, making an average charge for a family of five for water for domestic purposes less than three cents a day or between nineteen and twenty cents per week."

The Second General Meeting of the International Chamber of Commerce is to be held in Rome during the week of March 19, 1923.



*The traveling laboratory called "Holmes," used for demonstrating methods.*

# The Boiler Feeder you have been waiting for




Cameron "WV" Boiler Feed Pump
Installed in an Eastern Plant



Outstanding Features—

- No couplings—No valves
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- Reduced floor space
- Horizontally split casings
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- No pipe vibration
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**For plants up to 2000 Boiler Horse Power 150 pounds pressure**

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The outstanding feature of this Pump is its simplicity. The single-stage impeller and turbine rotor are mounted on the same shaft. The absence of a coupling and the compact design results in a remarkably large capacity per unit of floor space required.

With this unit the small boiler plant can now secure the outstanding advantages of a Centrifugal Boiler Feed Pump.

Let us send you Bulletin 7056.
Our Engineers are at your service.
Write our nearest office.

**A. S. Cameron Steam Pump Works**
**11 Broadway, New York**
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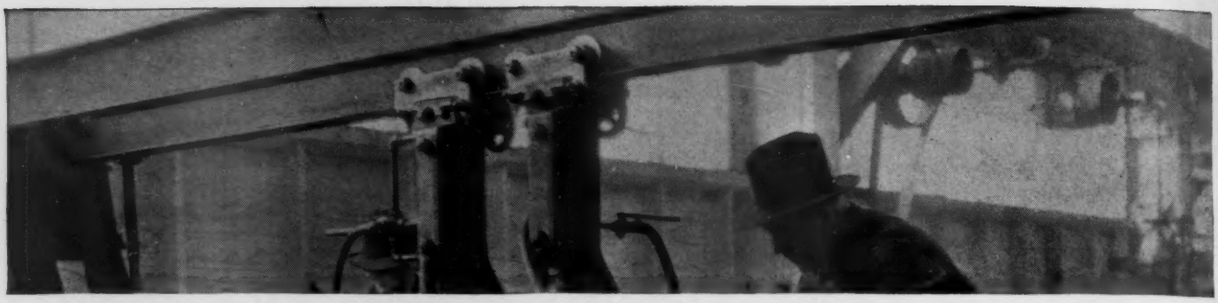
# Cameron Pumps



# THIS HOSE SAVES POWER, TIME, AND LABOR



The use of Goodyear Monterey Air Hose returns real cash savings. First of all, this durable hose saves the replacement cost of ordinary hose, not once, but several times during its extraordinarily long life.

Added to this are other advantages: it saves power because it is air tight under the highest pressures; it saves time because it is light in weight, non-kinking, easily handled and needs no attention; it saves labor by these same features, frequently eliminating the need for an assistant since the operator can handle his implement without help.

"Goodyear Monterey" is a real air hose. Its body is of stout, rubber-impregnated plies of duck, resilient to withstand pulsating pressures without internal wear. Its cover is of a tough rubber that resists abrasion when dragged or scrapped. The tube is of a special compound that puts up a stubborn resistance to oils.

Though pinched or flattened, Goodyear Monterey Air Hose returns to full shape when released. Its scientific construction eliminates the need for wire winding.

Use this economical hose in any pneumatic tool work. If you want to know more about this, or other kinds of Goodyear Hose, write to the nearest Goodyear Branch or direct to Goodyear, Akron, Ohio, or Los Angeles, California.

*Goodyear Means Good Wear*

# GOODYEAR AIR HOSE

*As a matter of reciprocal business courtesy help trace results*

# CONTENTS OF THIS ISSUE

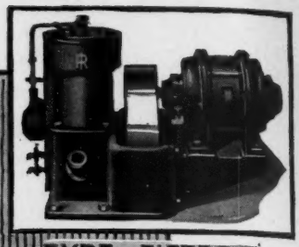
Vol. XXVII, No. XII, December, 1922

*NOTE—For subscription terms see first Editorial page*

## Articles



## Advertisements



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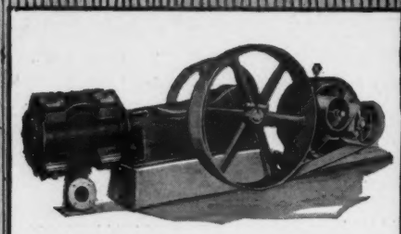

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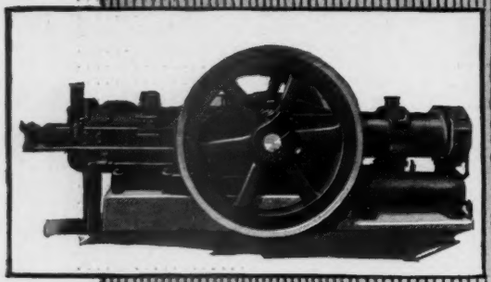

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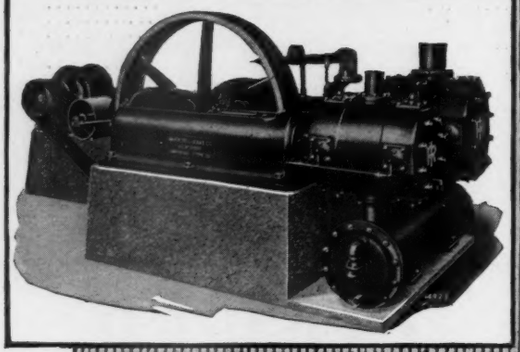

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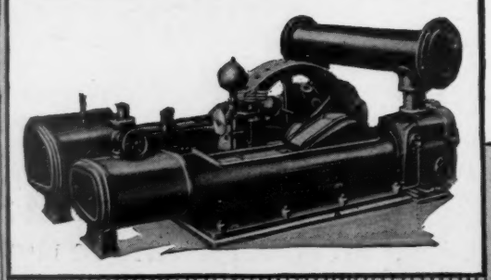
Each type of Ingersoll-Rand Compressor is described in detail in profusely illustrated bulletins. We will be pleased to send you copies describing the types in which you are interested.



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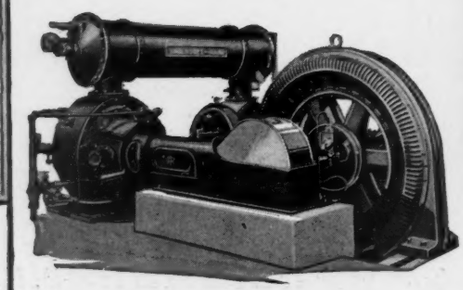

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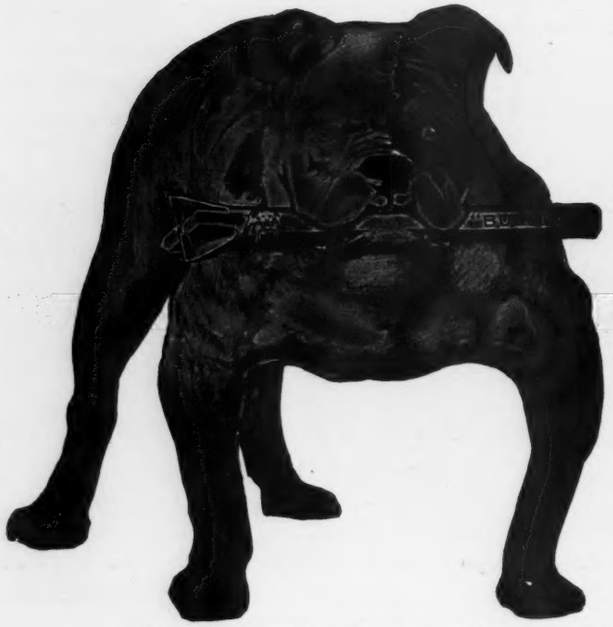

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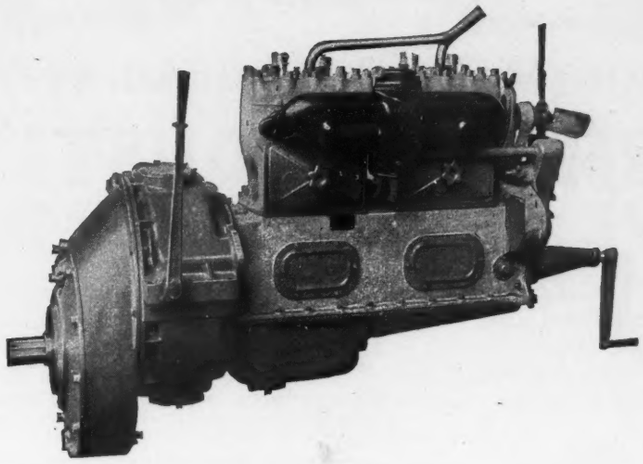

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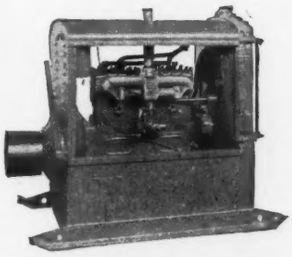
TRADE MARK

**High Torque Motors**

**Maximum Pull at Usable Speed**

# A Dependable Industrial Power Unit



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The Waukesha Industrial Unit adapts itself to all kinds of work where a portable, stationary, Four Cylinder Motor is desired. It is supplied in sizes from 15 to 45 horsepower.

Waukesha Motors are becoming as well known as industrial units as they are in truck and tractor field and the same efficient service is available. They are easily portable to attach to any machine requiring belt power.

Complete information and installation blue prints on request.

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**The World's Largest Exclusive Builders of Truck, Tractor and Industrial Motors**

**Saves more than 50% Power Costs alone compared with Air Power**

# DORMAN SELF CONTAINED DUSTLESS WAVE POWER ROCK DRILL

INDEPENDENT Rotation of the Drill Steels. No Splines used
Any Drill Steel used from 1-in. to 4-in. bits with one chuck only.

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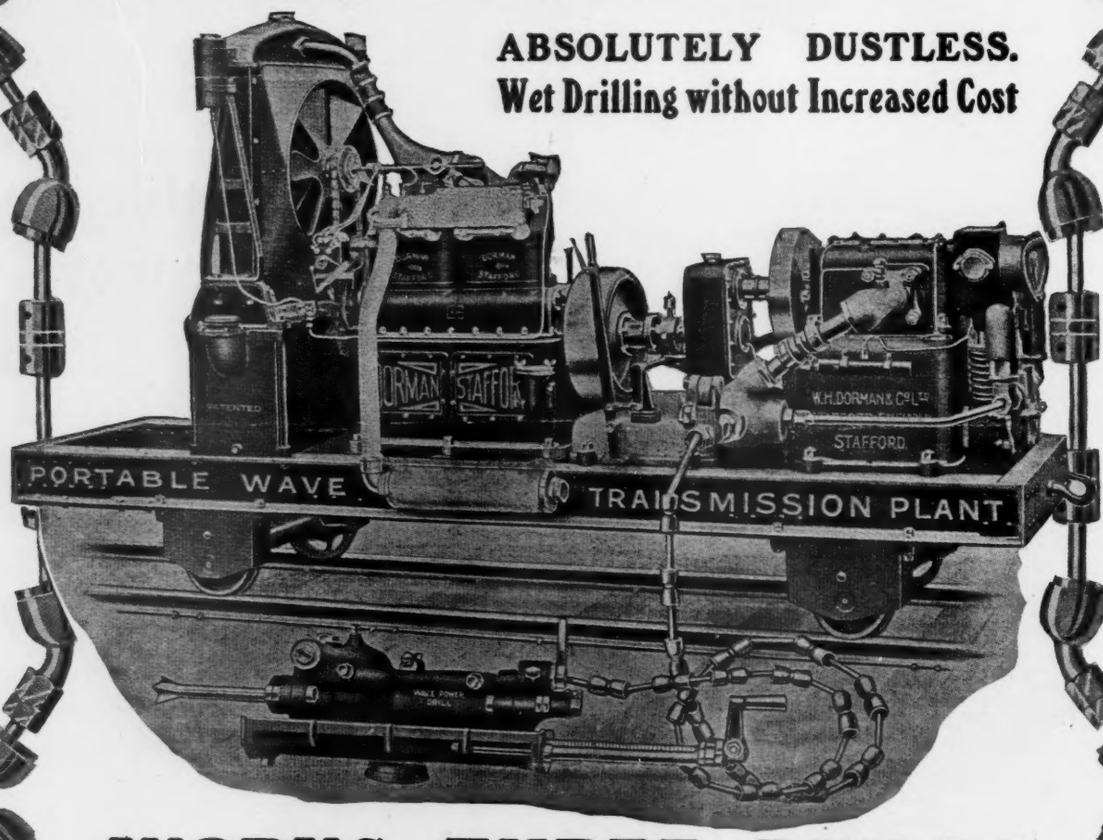


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**Dorman's Patented Flexible Joints used with Hose is a guarantee against Hose Breakages at acute working angles. FLEXSTEL Joints reduce Hose renewals and maintenance costs**

DORMAN'S PATENTED EXPANSIBLE AND FLEXIBLE JOINTS in Steel and other Metals from ¼ in. to 16 in. bore. Guaranteed to withstand successfully the highest fluctuating and intermittent pressures for WATER, OIL, GAS, AIR, PETROL, ACIDS, SATURATED or SUPERHEATED STEAM, and for many trades and purposes. Joints are Standardised and Interchangeable. A line can be quickly and easily lengthened or shortened by unskilled labour without wasting any section.

## STRIKING and UNIQUE PRACTICAL FACTS about FLEXSTEL

Dorman's in trying to get a successful and reliable flexible pipe line for Wave Transmission made thousands of experimental tests with all classes of Armoured and other Hoses of British, Continental and American manufacture—*all were failures.* Flexstel for years has been successfully used in the developments of the Dorman Wave Power Plants which are at work in England and Abroad giving excellent results.

**FLEXSTEL Flexible Pipe Line attached to Wave Power Drill** is the ONLY Piping Guaranteed to Permanently and successfully stand up to the Intermittent Pressures of the Waves of Compressed Fluid travelling in the Pipe Line from 2,400 to 30,000 waves per minute at the speed of sound in water, ONE MILE PER SECOND.

# DESCRIPTION OF DORMAN SELF-CONTAINED DUSTLESS WAVE POWER ROCK DRILL

A Three Drill Self-contained Wave Power Plant is permanently fixed on a Steel Frame Trolley to run on a 2ft. 6in. gauge railway, and consists of a 4 cylinder Dorman Petrol Engine, 36 R.A.C rating, coupled to a Wave Generator (Patented) through an ordinary gear-box and clutch. Can be designed for Engine, under its own Power, to move the complete unit any distances. Rails not necessary.

**THREE** Cradle mounted Dustless Rock Drills can be worked simultaneously or intermittently, each on a separate Pipe Line at a length of **One Hundred and Thirty** feet each drill.

Or, **Two** Cradle mounted Dustless Rock Drills can be worked simultaneously or intermittently, each on a separate Pipe Line at a length of **Two Hundred and Fifty** feet each drill.

Or, **One** Cradle mounted Dustless Rock Drill can be worked at a length of **Five Hundred** feet.

Several separate pipe lines of 500 ft. each can be in economic use serving in rotation the several districts of the Quarry One Drill continuously at work while the other rock faces are being cleared.

The Power Input through Generator instantaneously and automatically adjusts itself to the varying working load to correspond with the number of Dustless Rock Drills being operated at any one time. Immediately one or more drills are shut off or temporarily stopped, the Power Input automatically reduces itself to the minimum power demanded There is no heavy idle load.

The "Dorman" Engine is a standard design with all working parts standardised and interchangeable and giving ample reserve power. If necessary can be adapted to run on Paraffin. The Oil Lubrication of Engine and Wave Generator is automatic. The complete Generator Plant can be left unattended for long working periods. The Plant can be worked by unskilled labour. The working pressures are within perfectly safe limits. Wave Power is transmitted through "Flexstel"—a Patented Flexible Steel Pipe Line tested hydraulically up to 9 tons pressure per square inch Wave Power can be transmitted through permanently fixed plain piping. The complete equipment is made to withstand the roughest usage of practical mining.

There are **no Mechanical Springs** in the Equipment, as the basic scientific principle of Wave Transmission, viz., the Storage of Enery in fluids is practically applied. **A distinct feature of the Dustless Rock Drill is the independent rotation of the Drill Steels. No Splines used.** Any ordinary standard Drill Steels can be used with any Wave Plant. The Cradle is made to suit standard rigs.

Water—the medium for carrying the Wave Power—is continuously passed under pressure down the centre of the drill steel to the drill point, and this supply can be controlled and varied by the Operator as he works the Drill The running water helps to keep the Drill cool.

The prompt and continuous clearance of debris eliminates the cushioning effect associated with air drilling, and the natural result is the drilling speed of Wave Power correspondingly increases. The drill always working on the virgin face of the rock Dry drilling, if required, can be done on a closed Water Pipe Line, and does not involve any serious or expensive alterations in the Wave Equipment.

**Wave Power reliably secures dustless rock drilling without extra water cost. With certainty it eliminates all dust, and effectually overcomes the cause—dry dust—that creates miner's Phthisis—the dreaded disease peculiar to the Mining Industry.**

**Actual comparative drilling results on hardest Cornish granite show a saving in power alone of more than 50% over compressed air. On the basis of equal power consumption the drilling results by Wave Power are more than double that by compressed air.**

Wave Plants work with any ordinary Drill Steels varying in diameter from 1 inch up to 4 inches at 2,400 blows per minute or whatever number of blows conditions require. One Chuck is only necessary for the whole range of Drill Steel sizes named.

Regular working Drilling speeds in **hardest Cornish Granite** as follows. In quarries other than Granite these speeds should be possible of improvement.

| Diameter of Bit | Rate of penetration | Diameter of Bit | Rate of penetration |
|---|---|---|---|
| 4 inch | 2 inches per minute | 2 inch | 10 inches per minute |
| 3½ " | 3 " " | 1½ " | 14 " " |
| 3 " | 4 " " | 1 " | 18 " " |
| 2½ " | 6 " " | | |

Experience proves that where the drilling hole traverses, fissures or joint planes, or where drilling is being done near a faulted zone, there is no jambing from these causes of the Wave driven drill

**W. H. DORMAN & CO., Ltd., STAFFORD.** Specialists in the Designing and Building of Petrol and Paraffin Internal Combustion Motor and Stationary Engines "The Heart of a Car is the Engine." Makers of Wave Transmission, Mining and other plants. Patent Owners and Makers of the Hele-Shaw Hydraulic (Oil) Clutch.

**Head Office and Works - - - - STAFFORD.** Telephone No.: 21 (2 lines) Telegrams "Dorman, Stafford."

**London Office - - 3, St. Bride's House, Salisbury Square, E.C.4** Telephone No 8157 Central Telegrams: "Typify, Fleet, London."

**This Border is a reproduction of Flexstel Patented Joints**

# The Economy of Knowledge

No. 2

of a series of articles picturing the influence of the engineer in the affairs of the world. Presented by the McGraw-Hill Company, Inc., whose publications have served the engineer through half a century of industrial progress.

One of the greatest needs of the world today is for accuracy. Accuracy in its teachings, in its actions, in its beliefs. This can only come through a knowledge of economic facts.

A man may learn to drive a nail precisely, but he is a dangerous man unless he knows the effect of the driving upon the materials into which the nail enters. Progress requires an exactness of information to meet the needs of this day when no man is independent of his fellows. Without this exactness, this accuracy, efforts at advancement are endangered, and progress becomes speculative.

The great dependency of the world upon its industrial organization, not alone for comforts but for the very vitals of life, dictates that haphazard be replaced by knowledge.

Industry exacts known values and processes for its operation. And there we have the potent reason for the ever-increasing supremacy of the engineer. But a few years ago, when demand paid whatever price was required, industry threw itself into a fury of production and thought this passing whirl-wind of effort was progress.

The cost of this effort has put the world in pawn, and our pride of achievement has been pricked by the sharp point of reality. We *thought* we were right. It did not require the engineer to prove we were wrong. The inevitable backward swing of the balance did that.

But it has necessitated the service of the engineer to show us wherein we were wrong; and how to set about reconstruction on the sound basis of facts.

At a costly price industry now recognizes its need of the engineer; his judgments, his analyses, his technical knowledge founded on economic facts.

And progress is now following the trails blazed by the engineer for the benefit of all men; for the engineer has proved the economy of knowledge.

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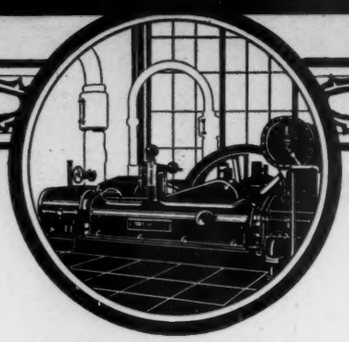

## Correct Lubrication for your air compressors

# The danger of deposits

TOO much oil induces carbon deposits. Carbonization may be slow at the start, but gains rapid headway as the deposits of excess oil and impurities increase and form obstructions on the discharge valve.

Anyone who has seen the restricted passages, due to carbonization, on an exhaust valve, can quickly visualize the dangers of such obstructions.

Excess of any oil will carbonize. Therefore, it is essential that the irreducible minimum quantity of oil be used.

You should always use an oil which will lubricate thoroughly when fed sparingly.

Many years of practical demonstration have established Gargoyle D. T. E. Oil Heavy Medium as the ideal air compressor lubricant. Its rich lubricating qualities permit it to be fed in minimum quantities, thus reducing carbonization,—the chief cause of air compressor troubles.

If you are not now using Gargoyle D. T. E. Oil Heavy Medium on your air compressors, we suggest that you get in touch with our nearest branch.

GARGOYLE

# Lubricating Oils

*A grade for each type of service*

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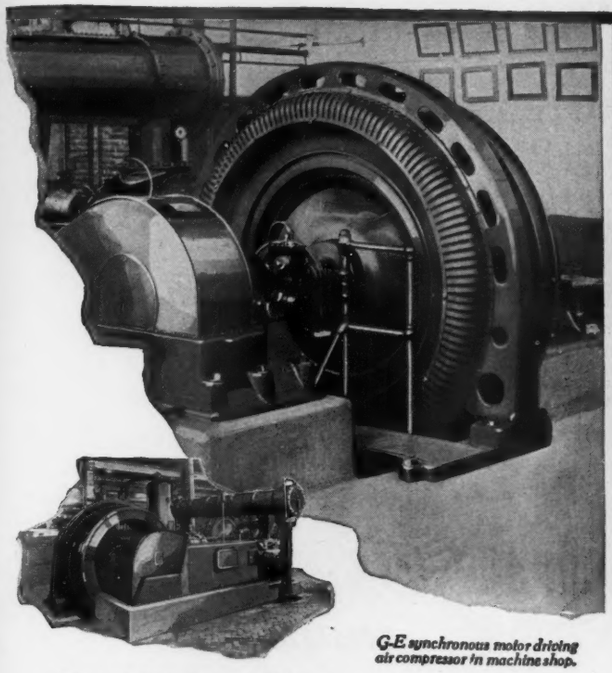
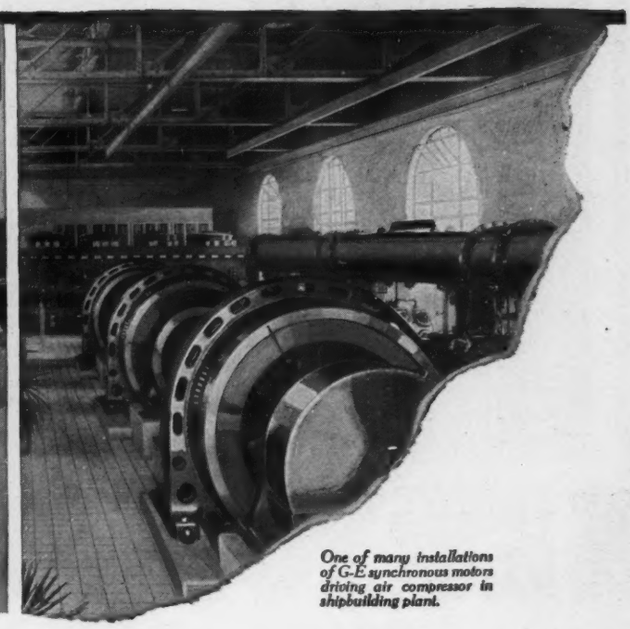
## VACUUM OIL COMPANY

# *In many mills, factories, and shops—synchronous motors are as essential to economy as good management*

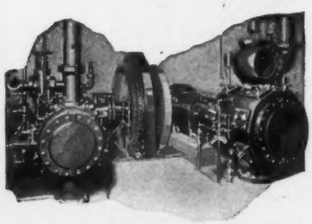


*A big electrical industry uses this G-E synchronous motor for driving air compressor.*

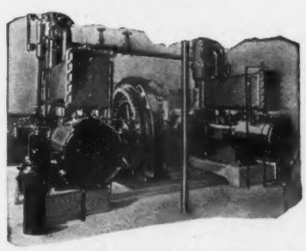


*One of many installations of G-E synchronous motors driving air compressor in shipbuilding plant.*

*G-E synchronous motor driving air compressor in machine shop.*



*G-E synchronous motor driving air compressor in automobile factory.*



*Mining industry also uses G-E synchronous motor drive for air compressors.*

## G-E Synchronous Motors--- *the* Drive for Air Compressors

During the last four years 927 G-E synchronous motors aggregating 307,000 horsepower have been installed for air compressor drive the country over.

The general adoption of synchronous motors for this type of drive is an acknowledgment of the claims long made for them. In steel mills, railroad shops, shipyards, mines, automobile plants, and other important industries—many air compressors are driven by these dependable, high power factor synchronous motors.

The proved efficiency of G-E synchronous motors—practically the same from full to half load—and falling off only slightly at quarter load—makes them money savers for their users. Designed to operate at unity power factor, they improve the power factor of the system—and with a normal field excitation they continue power factor improvement when underloaded. Due to large air gap, which is five to eight times that of an induction motor, slight bearing wear does not impair the motor's operating characteristics. This is a big point where continuous operation is essential.

A G-E synchronous motor working with a standard air compressor will give uninterrupted service at low cost. Bulletin 41310 tells more about synchronous motors—our nearest office will gladly send it upon request.

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# "BLUE BIRD" AIR DRILL HOSE

**The BRAIDED WIRE CABLE reinforcement—really FOOL PROOF ARMORING.**

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**REMEMBER!—"BLUE BIRD" will not remain crushed. The cover (blue rubber) will not cut readily.**

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# NEW YORK RUBBER Co

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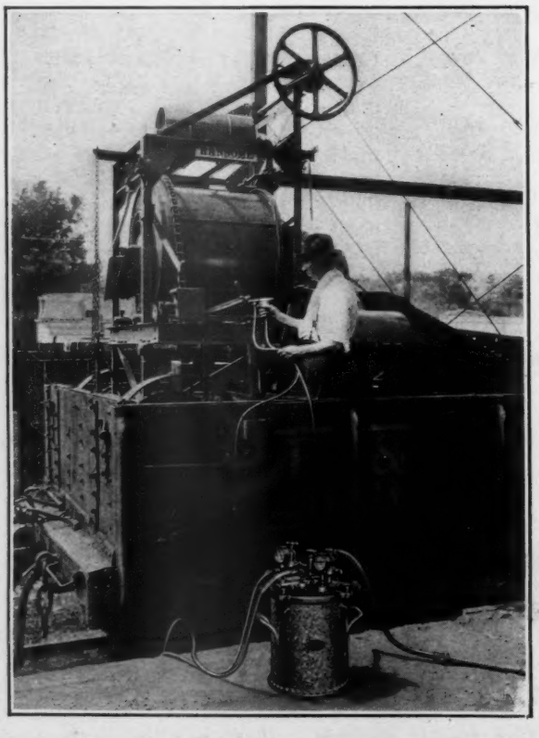
## Why Does The Ransome Concrete Machinery Co. Use Eclipse Model "G" *Low Pressure* Air Brush?



***It Saves:***

***Labor***—Replacing five hand painters.

***Paint***—Using less paint for a given job—no waste.

***Power***—Consuming half as much air as any other spraying machine. Electric compressors to operate from a lighting plug—or gasoline driven—both portable, or from main air line.

***Bristles***—Eliminating dipping and dripping and cost of bristle brushes. Applying any paints that can be hand brushed and many that cannot, without special preparation.

***Surface***—Protecting and decorating in a satisfactory manner.

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# PERMANENCE

HERE is a Terry performing under difficulties. Installed in a marble quarry, exposed to the elements, clamped to irregular rocky surface without grouting, strained by unsupported pipes —but still it functions and drains the water from the quarry so that beautiful building material can be removed. It may be a long way from the statue of Venus to a Terry turbine, but though it was once stormed by the elements and buried in volcanic dust, Venus has been restored to us and still functions as a work of art. We can only surmise what beauty this statue might now possess had it received the protection such creations should have. But, we know what Terry turbines will do under the care and protection of the modern power plant, for ninety-six of the first hundred Terrys which were made some twenty years ago are still in operation. Inbuilt permanence is a Terry feature which you should consider.

T-776

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# IT REMOVES WATER FROM COMPRESSED AIR

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## STRATTON AIR SEPARATOR

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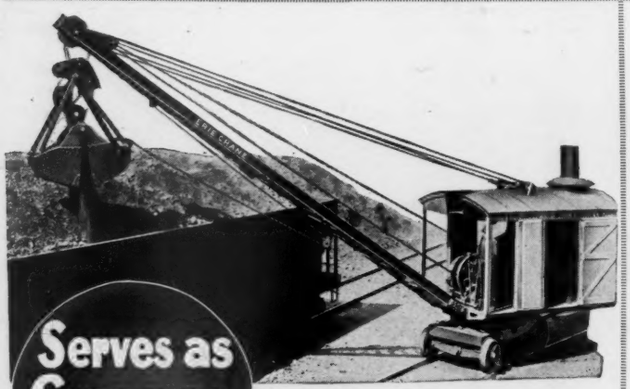

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**For unloading and storing your coal and other bulk materials—ore, ashes, etc.; for moving heavy machinery around the plant; for loading scrap with a magnet—USE YOUR ERIE AS A LOCOMOTIVE CRANE.**

Then where you have cellar excavating to do, or grading for a plant extension, or any other kind of excavating—**your ERIE serves as a powerful steam shovel.** Easily changed over in a few hours, by any ordinary mechanic.

You get the use of two machines at the cost of one—you are ready for any kind of material handling or excavating.

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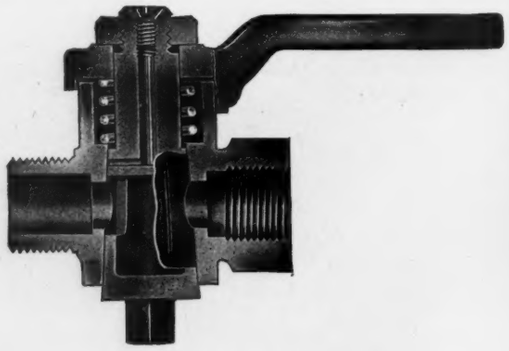
**ERIE Locomotive Cranes**



**The illustration is from a photograph of a "Victory" Lubricated Air Cock cut in half.**

**Notice the heavy and uniformly thick walls,—the heavy coil spring;—the canals for lubricant.**

**These are some of the reasons why the "Victory" Lubricated Air Cock is 100% efficient.**

**Let us send you our catalog.**

**Victory Equipment Corporation**

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## Flexible Steel Armored Hose Will Stand the Gaff

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Sprague steel Armored Hose can be dragged over ragged rock surfaces without fear of damage.

It is especially designed to overcome the faults common to ordinary compressed air hose.

Put in a trial order now.

Once acquainted with Sprague Steel Armored Hose you will never return to the other.

**Write for further information**

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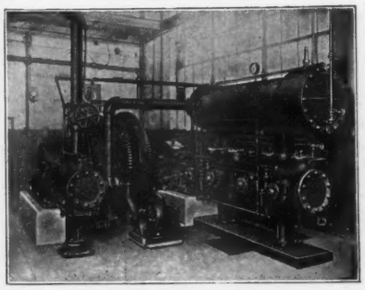

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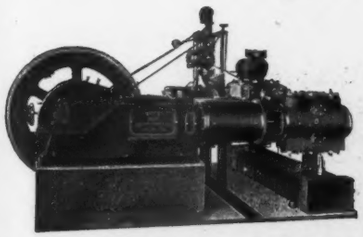

*Class "CCS"*

Bury Universal type, Duplex, Compound, Steam driven. Built in capacities from 450 to 3000 cubic feet per minute.

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A press of the button gives a good strong blast of air.

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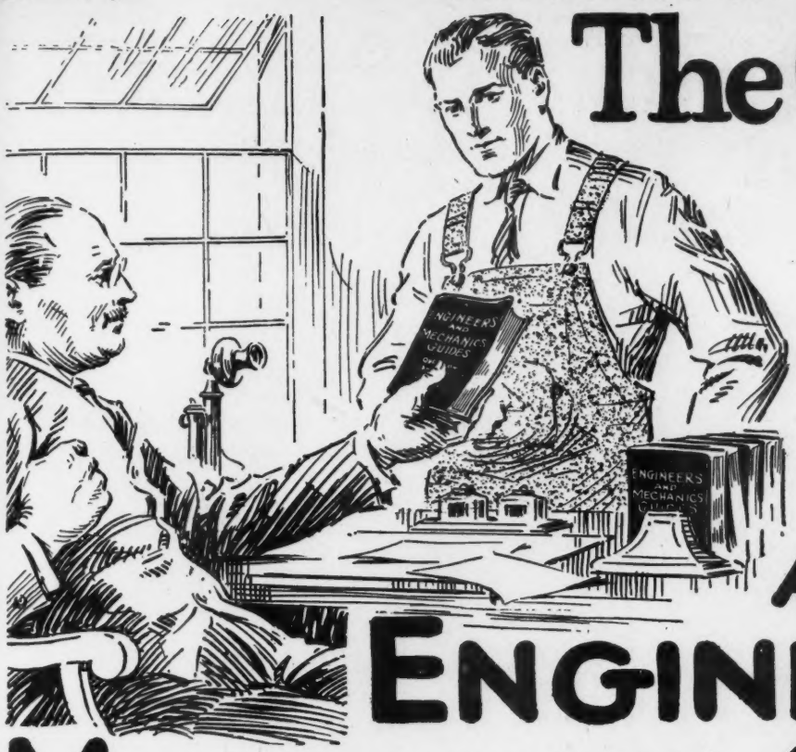
Note: Please write in margin below, and include with coupon, number of places you can use air guns.

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For general boiler work and chipping castings, the No. 3S (3″ stroke) "LITTLE DAVID" Chipper is best.

If considerable light work is to be done and a lighter hammer is wanted, the No. 2S (2″ stroke) hammer is the right tool to use.

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## *"Little David" Chippers*

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